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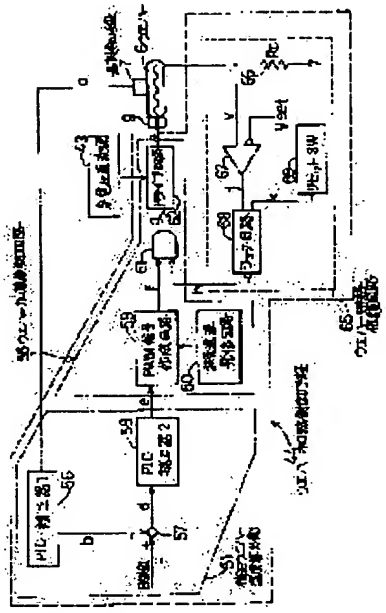
(54) STERILE BONDING DEVICE FOR FLEXIBLE TUBE

(57)Abstract:
PURPOSE: To reduce consumed power, and allow the temperature control of a wafer by controlling a constant voltage source for heating the wafer for fusing and cutting a flexible tube on the basis of the detected temperature of the wafer.
CONSTITUTION: A wafer heating control means 44 has a deviation signal output part 57 for outputting a deviation signal (d) between a corrected temperature (b) calculated by the PID corrector 56 of a corrected wafer temperature calculating part 51 on the basis of the output (a) of a temperature detecting means 7 and a target heating temperature (c) of a wafer, and outputs a corrected deviation signal (e) by a PID corrector 58. Pulse width modulation signal output parts 59, 60 output a pulse width modulation signal (f) on the basis of the corrected deviation signal (e). Further, the wafer heating control means 44 has a drive circuit 62 for controlling a constant voltage source 43 by the pulse width modulation signal (f) and a pulse width modulation signal control part 61 for controlling the inflow of the pulse width modulation signal (f) from the pulse width modulation signal output part 59 to the drive circuit 62 on the basis of the detection signal (h) of the wafer short-circuit detecting parts 67, 58 of a wafer short-circuit protecting circuit 65.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It is equipment for joining a flexible tube in sterile. This equipment The 1st clamp and the 2nd clamp which hold at least two flexible tubes in the parallel condition, The cutting means for cutting said flexible tube between this 1st clamp and the 2nd clamp, It has the migration means to which either [at least] said 1st clamp or said 2nd clamp is moved so that both the edges to which the flexible tube cut by this cutting means is joined may stick. A wafer for said cutting means to carry out melting cutting of said flexible tube, It has the source of a constant voltage, wafer temperature detection means, and wafer heating control means for heating this wafer. Said wafer heating control means Flexible tube sterile junction equipment characterized by being what has the Pulse-Density-Modulation signal output part computed based on the output of said wafer temperature detection means, and controls said source of a constant voltage by this Pulse-Density-Modulation signal.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention carries out heating fusion of at least two flexible tubes, and relates to the flexible tube sterile junction equipment for connecting in sterile.
[0002]
[Description of the Prior Art] At the time of tube connection of the blood collecting bag in a transfusion system and a constituent-of-blood bag, and exchange of the dialysing fluid bag in continuous ambulatory PD (CAPD), and a waste fluid bag, it is necessary to connect a tube in sterile. As equipment which makes sterile connection of such a tube, it is shown in JP,61-30582,B and there is a thing. The equipment shown in this JP,61-30582,B The 1st clamp and the 2nd clamp which are the tube contact which carries out heating fusion of the tube and is connected, and hold two flexible tubes which should be connected in the parallel condition, It has the cutting means for cutting a flexible tube between the 1st clamp and the 2nd clamp, and the migration means to which either [at least] the 1st clamp or the 2nd clamp is moved so that both the edges to which the flexible tube cut by the cutting means is joined may stick.
[0003] And the cutting means has the wafer for carrying out melting cutting of the flexible tube, and the power source for heating a wafer. As a power source for heating a wafer, the constant current source is used as shown in JP,59-64034,A. And the approach of predicting the temperature of a wafer from resistance is used for the temperature control of a wafer using the resistance temperature change of a resistor.
[0004]
[Problem(s) to be Solved by the Invention] However, by the approach the temperature control of a wafer predicts the temperature of a wafer from resistance using the resistance temperature change of a resistor using a constant current source, it actually has the trouble that it is difficult to perform positive temperature control since the temperature of a wafer is measured and it does not control as shown in JP,59-64034,A. furthermore, in the heating circuit using a constant current source, since loss of a drive circuit was large, it may be easy to be large [power consumption] and the trouble also had it. Then, the purpose of this invention can perform certainly temperature control of a wafer for heating melting to cut a flexible tube, and offers flexible tube sterile junction equipment with little power consumption further.
[0005]
[Means for Solving the Problem] It is equipment for joining a flexible tube in sterile which attains the above-mentioned purpose. This equipment The 1st clamp and the 2nd clamp which hold at least two flexible tubes in the parallel condition, The cutting means for cutting said flexible tube between this 1st clamp and the 2nd clamp, It has the migration means to which either [at least] said 1st clamp or said 2nd clamp is moved so that both the edges to which the flexible tube cut by this cutting means is joined may stick. A wafer for said cutting means to carry out melting cutting of said flexible tube, It has the source of a constant voltage, wafer temperature detection means, and wafer heating control means for heating this wafer. Said wafer heating control means It is flexible tube sterile junction equipment which is what has the Pulse-Density-Modulation signal output part computed based on the output of said wafer temperature detection means, and controls said source of a constant voltage by this Pulse-Density-Modulation signal.
[0006] And said wafer heating control means has the deflection signal output part which outputs the deflection signal of the amendment wafer temperature calculation section, the amendment temperature computed by this calculation section, and whenever [purpose stoving temperature / of said wafer] based on the output of said wafer temperature detection means, and, as for said Pulse-Density-Modulation signal output part, it is desirable that it is what outputs a Pulse-Density-Modulation signal based on this deflection signal. Furthermore, as for said wafer heating control means, it is desirable to have the wafer short circuit

protection network. Moreover, said wafer heating control means has the drive circuit for controlling said source of a constant voltage by this pulse-width-modulation signal, and, as for said wafer short circuit protection network, it is desirable to have the short circuit detection section of said wafer and the pulse-width-modulation signal-control section which controls an inflow in said drive circuit of the pulse-width-modulation signal from said pulse-width-modulation signal output part based on the detection signal of this short circuit detection section. Moreover, as for said amendment wafer temperature calculation section, it is desirable to have proportionality, the integral, and the differential correction circuit. Furthermore, as for said deflection signal output part, it is desirable to have proportionality, the integral, and the differential correction circuit. And as for said wafer temperature detection means, it is desirable that they are a thermocouple or a resistance bulb. Furthermore, as for said wafer temperature detection means, it is desirable that they are a sheath form thermocouple or a resistance bulb.

[0007] Then, the flexible tube sterile junction equipment of this invention is explained with reference to a drawing. The 1st clamp 3 and the 2nd clamp 2 which this flexible tube sterile junction equipment 1 is equipment for joining a flexible tube in sterile, and hold at least two flexible tubes in the parallel condition, The cutting means 5 for cutting the flexible tubes 48 and 49 between the 1st clamp 3 and the 2nd clamp 2, It has the migration means to which either [at least] the 1st clamp 3 or the 2nd clamp 2 is moved so that both edges 48a to which the flexible tubes 48 and 49 cut by the cutting means 5 are joined, and 49a may stick. The wafer 6 for the cutting means 5 to carry out melting cutting of the flexible tubes 48 and 49, It has the source 43 of a constant voltage, the wafer temperature detection means 7, and the wafer heating control means 44 for heating a wafer 6. The wafer heating control means 44 Based on the output of the wafer temperature detection means 7, it has the Pulse-Density-Modulation signal output part 59 computed, and the source 43 of a constant voltage is controlled by the Pulse-Density-Modulation signal.

[0008] Drawing 1 is the perspective view of one example of the flexible tube sterile junction equipment of this invention, drawing 2 is the perspective view showing the condition contained in the case the sterile junction equipment shown in drawing 1 , drawing 3 is the block diagram showing an example of the electrical circuit used for the sterile junction equipment of this invention, and drawing 4 is the electrical circuit block diagram showing an example of the wafer heating control means of the electrical circuit of the sterile junction equipment of this invention. Drawing 5 is the plan of one example of the flexible tube sterile junction equipment of this invention.

[0009] Next, the wafer heating control means indicated to drawing 4 is explained. What has the metal plate bent as a wafer 6 so that it might face each other, the insulating layer formed in the inside of this metal plate, the resistor formed so that the above-mentioned metal plate might not be contacted in this insulating layer, and the terminal for energization prepared in the both ends of this resistor is used suitably. And since a resistor generates heat by energization, generation of heat of a resistor is conducted to a metal plate, and the whole wafer generates heat by energization. And resistance changes with generation of heat according [a resistor] to energization. Therefore, the source of a constant voltage is only used and temperature control of enough wafers cannot be performed only by adjusting the electric power supply to a wafer. So, with the sterile junction equipment 1 of this example, it has the wafer heating control means.

[0010] As shown in drawing 4 , as for the wafer heating control means 44, it is desirable to have the wafer heating control circuit 55 and the amendment wafer temperature calculation circuit 51, and to have the wafer short circuit protection network 65 further, as shown in drawing 4 . The wafer heating control circuit 55 has the Pulse-Density-Modulation signal output part 59 computed based on the output of ** from the temperature detection means 7, and controls the source 43 of a constant voltage by the Pulse-Density-Modulation signal. Having the deflection signal output part 57 which outputs the deflection signal of the amendment temperature specifically computed by the amendment wafer temperature calculation section 56 which computes amendment wafer temperature, and the calculation section based on the output of the wafer temperature detection means 7, and whenever [purpose stoving temperature / of a wafer], the Pulse-Density-Modulation signal output part 59 outputs a Pulse-Density-Modulation signal based on a deflection signal. As a temperature detection means 7, it is desirable that they are a thermocouple or a resistance bulb. More preferably, it is a sheath form thermocouple or a resistance bulb, and a sheath form thermocouple is desirable especially.

[0011] If the heating control means 44 is more concretely explained using drawing 4 , the temperature detection signal a from the thermocouple which is the temperature detection means 7 will be inputted into the PID amendment machine 1 (proportionality and differential / integral amendment machine 1) which is the amendment wafer temperature calculation section 56, and the amended amendment temperature signal b will be outputted. With this PID amendment machine 56, it is formula 1b=1-/K-a- (1+K1 and T-da/dt), for

example... (1)
It is alike and correction value is computed more. K is the coupling coefficient of a wafer and a thermocouple, K1 is a correction factor resulting from the flexible tube cut, and T is the thermal time constant of a thermocouple. The purpose which performs such amendment is to perform [performing amendment (K) based on the heat-conduction loss between a wafer and a thermocouple, and] amendment in consideration of the thermal time constant (T) of a thermocouple. And as shown in a formula 1, the amendment temperature signals1/K are highly computed by K1 and T-da/dt, while wafer temperature is rising from the surveyed wafer temperature signal a, since b is a constant. The temperature which a thermocouple detects is the internal temperature of a thermocouple, and has delay to the skin temperature of a wafer. However, since the delay of a thermocouple is approximated to first-order lag, it considers as a time constant T and the secondary progress operation of a time constant T is conversely performed as a correction function by performing the above-mentioned amendment, wafer skin temperature is correctly [without a time lag] computable.
[0012] Moreover, exact wafer skin temperature is correctly [without a time lag] computable by performing amendment as shown in a formula 1 also at the time of wafer temperature descent. And it will become a formula 2 if a formula 1 is rewritten in consideration of a sampling time (**t).
b(t+**t) =1-/K-a(t+**t) - {1+K1.T/**t- [a(t+**t)-a (t)]} ... (2)
Thus, the amendment temperature signal b computed is compared with the target wafer temperature signal c, and the deflection signal d is outputted by the deflection signal output part 57. This deflection signal d is inputted into the PID amendment machine 2 designed by the suitable transfer function in order to raise the responsibility of a control system, and it is outputted as an amendment deflection signal e. This amendment deflection signal e is inputted into the PWM (Pulse Density Modulation) signal creation circuit 59. The PWM signal creation circuit 59 synchronizes with the predetermined frequency created by the above-mentioned amendment deflection signal e and the above-mentioned subcarrier oscillator circuit 60, and outputs the signal (pulse train signal which carried out the PWM modulation) f of the pulse width proportional to the amendment deflection signal e. This pulse train signal f passes along a gate circuit 61, and flows into the drive circuit 62. The drive circuit 62 is constituted by a transistor, a thyristor, etc. which are a solid-state-switching component, inputted pulse train signal g acts as switching and a timing signal, and only when pulse train signal g is in the condition of H, the source of a constant voltage and a wafer are connected. Connection between the drive circuit 62 and a wafer 6 is made with the connection terminal 9. The source 43 of a constant voltage and a wafer 6 are intermittently connected based on pulse train signal g, and a wafer is controlled by the wafer temperature made into the purpose.
[0013] And when the outline of the heating circuit in the case of constant-current system comes to be shown in drawing 19 and loss of the heating circuit of constant-current system is searched for, loss (Wo) is Wo'= (Vi-Vo) Io and is Wo'= [Vce+ {(Vi-Vce) -Vo}] and Io. It is set to (A). Moreover, the outline of the heating circuit in the case of PWM comes to be shown in drawing 20 , and loss (Wo) of a drive circuit is Wo=Vo/Vi-Vce-Io+W1 (B),
W1 is the switching loss of the transistor which constitutes a drive circuit. And generally a comparison of Wo and Wo' materializes the following relation in B type.
Generally in Vo/Vi-Vce-Io>W1, next A type, the following relation is realized.
Vce<<(Vi-Vce)-Vo -- if this compares the 1st item of A type and B type, and the 2nd item -- Vo/Vi-Vce-Io<Vce-IoW1<(Vi-Vce)-Vo} and Io -- therefore it becomes Wo<Wo' and the PWM of power consumption is smaller compared with constant-current system.
[0014] Next, a wafer short circuit protection network is explained using drawing 4 R> 4. In a normal state, since the signal j from a comparator 67 is not inputted into a latch circuit 68, the latch circuit 68 is always outputting the signal of H to a gate circuit 61 (AND circuit). For this reason, a gate circuit outputs Signal g to the drive circuit 62 according to ON/OFF (H/L) of the PWM signal f. And as shown in drawing 4 , the shunt resistance 66 is connected electrically and the electrical potential difference V of the shunt resistance 66 is compared with the wafer 6 by the comparator 67 with the programmed voltage Vset. In a normal state, since it is lower than a programmed voltage Vset, Signal j is not outputted for the electrical potential difference V during shunt resistance from a comparator 67. However, if a wafer 6 short-circuits, since the current beyond a convention will flow to the shunt resistance 66, if the electrical potential difference V of the shunt resistance 66 rises and it becomes large from a programmed voltage Vset, Signal j will be outputted to a latch circuit 68 from a comparator 67. The latch circuit 68 has the function to hold the condition, once Signal j is inputted. For this reason, once Signal j is inputted, the signal of L will always be outputted to a gate circuit 61 (AND circuit). For this reason, the signal g based on the PWM signal f is no

longer outputted to the drive circuit 62, and a circuit is protected from a gate circuit 61. And if a reset switch 69 is pushed after exchanging the wafer which caused short circuit accident, a latch circuit 68 will output the signal of H to a gate circuit 61 (AND circuit). Once reset-signal k is inputted, a latch circuit 68 will hold the condition and will return to a normal state.

[0015] Next, the device of the sterile whole junction equipment 1 is explained. This sterile junction equipment 1 has the 1st clamp 3 and the 2nd clamp 2 which hold at least two flexible tubes in the parallel condition, as shown in drawing 1 , drawing 2 , drawing 5 , and drawing 10 . By rotation of the gear 30 rotated by actuation of a motor, the gear 31 rotated by rotation of a gear 30, and a gear 31 The arm 18 for a drive for moving the prevention member 11 for preventing shakiness by the home position of the frame 9 to which the both ends of the shaft 32 to rotate and a shaft were fixed pivotable, and the 1st clamp 3, microswitches 13, 14, and 15, and the 1st clamp 3, and the 1st clamp 3 Shakiness of the cam 17 for making the cam 19, the cutting means 5, the cutting means 5, and the 2nd clamp for making it move drive, the press member 33 which presses the 2nd clamp 2 to the 1st clamp side, the specification-part material 25 which regulates the retreat location of the 1st clamp 3, and the 1st clamp 3 The induction member 26 for guiding the spring member 27 for preventing, the wafer exchange lever 22, the wafer cartridge 8, the wafer cartridge exchange lever 24, the used wafer housing grasping member 28, and a used wafer to a housing, the used wafer housing 29, and a control panel 50 It has.

[0016] And the 1st clamp migration device to which the 1st clamp 3 is moved so that both edges 48a from which this sterile junction equipment 1 was cut by the cutting means 5, and to which the flexible tubes 48 and 49 are joined, and 49a may face each other, It has the locomotive function for making a tubeside move the cutting means 5 (to upper part), and making it move in the direction (caudad) again separated from a tube after cutting, and the 2nd clamp migration device moved in the direction which approaches and estranges the 2nd clamp 2 to the 1st clamp 3. It is what makes it move to a cutting means drive up perpendicularly to the shaft of two tubes, and moves the cutting means 5 to it caudad after tube cutting. The 1st clamp migration device It is what moves the 1st clamp 3 in the rectangular direction in the level condition to the shaft of two tubes (concrete -- back) after tube cutting. the 2nd clamp migration device The 2nd clamp 2 is moved in parallel very only in the level condition to the shaft of two tubes so that the 1st clamp side may be approached.

[0017] Then, the 1st and 2nd clamps 3 and 2 are explained. The 1st and 2nd clamps 3 and 2 are constituted as shown in drawing 1 R> 1, drawing 5 , drawing 7 , and drawing 10 . Specifically, the 1st clamp 3 has base 3b, covering 3a attached in this base 3b pivotable, and clamp standing-ways 3c to which base 3b was fixed, as shown in drawing 10 . And this clamp standing-ways 3c is being fixed to the linear table. The linear table is constituted by 3n of rail members prepared in the lower part of movable carriage 3c fixed to the inferior surface of tongue of clamp standing-ways 3c, and movable carriage 3c. And on this linear table, to the shaft of the tubes 48 and 49 to join, there is no distortion and the 1st clamp 3 is moved so that a perpendicular direction and both the edges to which in other words the cut flexible tube is joined may face each other. Therefore, the 1st clamp migration device is constituted from sterile junction equipment 1 of this example by the above-mentioned linear table, a motor, a gear 30, the gear 31, the shaft 32, the arm 18 for a drive, and the cam 19. And with this junction equipment 1, as shown in drawing 1 and drawing 5 , the spring member 27 which connects the back of 1st clamp standing-ways 3c and the frame of junction equipment 1 is formed, the 1st clamp 3 is in the condition of always having been pulled back, and shakiness of the 1st clamp 3 (correctly 1st clamp standing-ways 3c) is made into few things. Moreover, as shown in drawing 1 R> 1 and drawing 5 , the prevention member 11 for preventing shakiness of the 1st clamp 2 in the tube stowed position (location in the condition that in other words the 1st clamp came out to the foremost) of the 1st clamp 3 is being fixed to the side face of a frame 9. Therefore, the 1st clamp 3 is in the condition back pulled by the spring member 27, i.e., the condition which does not have shakiness in a back side, and shakes and can move [at a tube stowed position] no longer ahead from it by the prevention member in the front. Therefore, the 1st clamp 3 consists of tube stowed positions so that there may be no shakiness. Moreover, as shown in junction equipment 1 at drawing 1 and drawing 5 , the specification-part material 25 which regulates the maximum migration location behind the 1st clamp 3 (correctly 1st clamp standing-ways 3c) is formed.

[0018] The 2nd clamp 2 has clamp standing-ways 2c by which covering 2a attached pivotable and base 2b were fixed to base 2b and this base 2b, as shown in drawing 5 , drawing 7 , and drawing 10 R> 0. And this clamp standing-ways 2c is being fixed to the linear table. The linear table is constituted by 2n of rail members prepared in the lower part of movable carriage 2c fixed to the inferior surface of tongue of clamp standing-ways 2c, and movable carriage 2c. And on this linear table, to the shaft of the tubes 48 and 49 to

join, the 2nd clamp 2 does not have distortion only in an parallel direction and the direction which approaches and estranges the 2nd clamp 2 to the 1st clamp 3, and, in other words, is moved to it.
[0019] Moreover, as shown in drawing 5 and drawing 7 , the press member 33 is formed between the frame of junction equipment 1, and clamp standing-ways 2c, and the 2nd clamp 2 (correctly 2nd clamp standing-ways 2c) is always pushed on the 1st clamp side. As a press member, a spring member is used suitably. And when that of a potato is used weakly and the thrust of the press member 33 grasps a flexible tube from the repulsive force of a flexible tube when grasping the 1st and 2nd clamps 3 and 2 as two flexible tubes 48 and 49 were crushed, this press member 33 is constituted so that the 2nd clamp 2 may move in the direction estranged a little from the 1st clamp 3. Therefore, the 2nd clamp migration device is constituted from sterile junction equipment 1 of this example by the above-mentioned linear table, a motor, a gear 30, the gear 31, the shaft 32, the cam 17, and the press member 33.
[0020] And as shown in drawing 10 , the 1st clamp 3 and the 2nd clamp 2 are constituted so that the tube to hold may be held in the condition of having crushed aslant. Clamps 3 and 2 have the coverings 3a and 2a attached in base 3b and 2b possible [revolution], and in base 3b and 2b, in order to **** two tubes, they have two slots 3f and 3e established in parallel, and 2f and 2e. And the serrated knife-like lock out members 3h and 2h are formed in the end face of base 3b of the part which Slots 3f and 3e and Slots 2f and 2e face, and 2b. And the lock out members 3g and 2g of the shape of a serrated knife of the configuration corresponding to the lock out members 3h and 2h of the above-mentioned base 3b and 2b are formed in Coverings 3a and 2a. The internal surface of Coverings 3a and 2a is flat. And to Coverings 3a and 2a, it has the revolution cam, respectively, and this revolution cam will engage with the roller of base 3b and 2b, if Coverings 3a and 2a are closed. And when Coverings 3a and 2a are closed, two tubes are aslant crushed by between 3h of lock out members of base 3b, and 3g of lock out members of covering 3a, and between 2h of lock out members of base 2b, and 2g of lock out members of covering 2a, and are held in the condition of having blockaded. Moreover, since the 1st clamp 3 has lobe 3i which projects in the 2nd clamp direction and it has crevice 2i to which the 2nd clamp 2 contains this lobe 3i, the 2nd clamp 2 is constituted so that it cannot blockade, if the 1st clamp 1 is not blockaded.
[0021] And two cams 19 and 17 are being fixed and sterile junction equipment 1 rotates cams 19 and 17 with rotation of a gear 31, as are shown in drawing 1 , and it has the gear 30 rotated by the motor, and the gear 31 rotated by rotation of this gear 30 and is shown in the shaft 32 of a gear 31 at drawing 7 . And cam-groove 19a for the 1st clamp drive of a configuration as shown in drawing 8 is prepared in the right lateral of a cam 19. And the arm 18 for the 1st clamp migration which has follower 18a which slides on the inside of cam-groove 19a of a cam 19 in the center section is formed. moreover, the lower limit of an arm 18 is supported by the frame 9 rotatable by supporting-point 18b, and the upper limit of an arm 18 is boiled by supporting-point 18c prepared in clamp standing-ways 3c of the 1st clamp 3, and is supported rotatable. Therefore, along with 3n of rail members of a linear table, as shown in drawing 8 , the 1st clamp 3 moves to the rectangular direction back in the level condition to the shaft of two tubes by rotation of a cam 19, as shown in an arrow head according to the configuration of cam-groove 19a.
[0022] The cutting means 5 has wafer attaching part 5a which holds a wafer exchangeable, arm section 5c in which wafer attaching part 5a was prepared caudad, follower 5b prepared in the edge of arm section 5c, and 5d of hinge regions and attachment section 5e to a frame 9, as shown in drawing 6 . And it can circle to a frame 9 by 5d of hinge regions. And as shown in drawing 6 , the temperature detection means 7 for temperature detection of the electrical connection terminal 9 for wafer heating and a wafer is being fixed to the right lateral of the cutting means 5. As a temperature detection means 7, it is desirable that they are a thermocouple or a resistance bulb. ** which is a sheath form thermocouple or a resistance bulb, especially a sheath form thermocouple are desirable more preferably. What has the metal plate bent as a wafer 6 so that it might face each other, the insulating layer formed in the inside of this metal plate, the resistor formed so that the above-mentioned metal plate might not be contacted in this insulating layer, and the terminal for energization prepared in the both ends of this resistor is used suitably.
[0023] And the cam 17 has cam-groove 17a for a cutting means drive in the left lateral, as shown in drawing 6 and drawing 9 . And follower 5b of the cutting means 5 is located in cam-groove 17a of a cam 17, and slides on the inside of cam-groove 17a in accordance with the configuration of a cam groove. Therefore, by rotation of a cam 17, as shown in drawing 9 , the cutting means 5 will move to a rectangular cross and the perpendicular direction upper and lower sides to the shaft of two tubes, if it puts in another way up and down according to the configuration of cam-groove 17a. Furthermore, the cam 17 has cam-groove 17c for the drive of the 2nd clamp 2 in the center section, as shown in drawing 7 . Cam-groove 17c has 17f of left laterals, and right lateral 17e, and controls the location of the 2nd clamp by 17f of left laterals, and right

lateral 17e. In 2nd clamp standing-ways 2c, it has the lobe extended caudad, and the follower 20 is formed at the tip. This follower 20 slides on the inside of cam-groove 17c for the drive of the 2nd clamp 2. And between the side faces of a follower 20 and cam-groove 17c, as shown in drawing 7 , it is formed so that the clearance between some may be made. And since 2nd clamp standing-ways 2c is always pushed by the spring member 33, in a normal state, a follower 20 comes to contact 17f of left laterals of cam-groove 17c, and the clearance between some is made between a follower 20 and right lateral 17e of cam-groove 17c. However, as mentioned above, if two tubes are held by the 1st and 2nd clamps 3 and 2, since it blockades and two clamps 3 and 2 hold, respectively so that two tubes may be crushed, they will arise [the repulsive force resulting from lock out of a tube]. And in the condition that clamps 3 and 2 hold a tube, since the thing of the force smaller than the repulsive force resulting from lock out of the above-mentioned tube is used, as shown in drawing 7 , a follower 20 comes to contact right lateral 17e of cam-groove 17c, and the clearance between some is made by the spring member 33 between a follower 20 and 17f of left laterals of cam-groove 17c. However, since the repulsive force to which a tube originates in cutting **** and lock out of a tube with the above-mentioned cutting means 5 disappears, return and a follower 20 come to contact 17f of left laterals of cam-groove 17c, and the clearance between some is made in a normal state between a follower 20 and right lateral 17e of cam-groove 17c. Thus, it is constituted so that the sliding surface of the cam groove which a follower 20 contacts may change with an operation of the spring member 33 and the repulsive force of a tube with time.

[0024] And as shown in drawing 7 , 17d of crevices is formed in 17f of left laterals. Since the stage when a follower 20 passes 17d part of this crevice is after cutting of a tube by the cutting means, a follower 20 is in the condition which meets and is sliding on 17f of left laterals of a cam groove 17, and, therefore, a follower 20 goes into crevice 17 part. For this reason, the 2nd clamp 2 will move in the 1st clamp 3 direction by the depth of 17d of crevices. Thereby, junction of a tube becomes more certain. And 17g of crevices is established also in right lateral 17e of cam-groove 17c. 17g of this crevice is a thing for cleaning of the inside of clamps 3 and 2. The 2nd clamp 2 can be moved in the direction estranged from the 1st clamp 3, and, thereby, a clearance is formed between the 1st clamp 3 and the 2nd clamp until a follower 20 contacts 17g of crevices by pushing the 2nd clamp 2 on the spring member 33 side by preparing 17g of this crevice. It becomes possible to clean with the cotton swab containing the solvent which can dissolve the formation ingredient of tubes cut to some extent, such as a cleaning member, for example, alcohol etc., into the formed gap. 17g of this crevice is established in the location which faces mostly 17d (part into which ****** of the 2nd clamp 2 is performed) of crevices of 17f of left laterals, as shown in drawing 7 . When the follower 20 formed in the lobe to which 2nd clamp standing-ways 2c is extended caudad is contained in 17d part of crevices, it is in the condition which joined both the tubes made into the purpose after tube cutting, and the 2nd clamp stops in this condition. Moreover, the 1st clamp is also already stopped and the 1st clamp 3 is in the location which shifted from the 2nd clamp. As shown in drawing 1 , the 1st clamp 3 is retreating from the 2nd clamp 2, and, specifically, the 1st clamp 3 has it in the location which shifted from the 2nd clamp. For this reason, in this condition, the inside of the point of the 2nd clamp 2 is exposed a little, and has also exposed the inside of the back end section of the 1st clamp a little further. Therefore, the cleaning is easy for the inside of the 2nd clamp 2 and the 1st clamp 3 which were exposed.

[0025] Next, an operation of the sterile junction equipment 1 of this invention is explained using a drawing. Drawing 11 is a timing chart which shows actuation of a cutting means, the 1st clamp, and the 2nd clamp. Drawing 12 , drawing 13 , and drawing 14 are the flow charts for explaining an operation of sterile junction equipment. Drawing 15 R> 5, drawing 16 , drawing 17 , and drawing 18 are the explanatory views for explaining an operation of sterile junction equipment. With this junction equipment 1, the 1st clamp 3 at the time of junction activity termination serves as a location which shifted from the 2nd clamp 2, and is in the halt location of the timing chart of drawing 11 . The include angle of the axis of abscissa of the timing chart of drawing 11 makes 0 degree a zero (condition whose location of the 1st clamp and the 2nd clamp suits), and, in other words, are angle of rotation of the shaft 32 of the subsequent gear 31, and a thing which shows the movement toward the cutting means at the time of angle of rotation of a cam 17 and a cam 19 (wafer), the 1st clamp 3, and the 2nd clamp 2.

[0026] First, as first shown in drawing 12 of a flow chart, the electric power switch 51 prepared in the panel 50 of drawing 3 is pushed. By CPU which constitutes by this the controller 40 shown in drawing 3 , when it judges whether it is normal (isn't there any omission of an internal connector, or isn't there specifically any open circuit of a thermocouple, or isn't there any defect in the source of an internal constant voltage?) and there is the above, a buzzer carries out singing of the junction equipment 1. Then, the clamp reset switch 53 prepared in the panel 50 of drawing 3 R> 3 is pushed. By CPU, it judges whether the 1st and 2nd clamps are

open, whether there are any 1st and 2nd clamps in a zero, and whether a wafer exchange lever is in a zero. In addition, since the clamp used with the sterile junction equipment 1 of this example has lobe 3i to which the 1st clamp 3 projects in the 2nd clamp direction as mentioned above and it has crevice 2i to which the 2nd clamp 2 contains this lobe 3i, the 2nd clamp 2 is constituted so that it cannot blockade, if the 1st clamp 1 is not blockaded. For this reason, it is detected by the microswitch 13 with which ON/OFF of the 1st and 2nd clamps being open is carried out by the lever 16 which contacts, and this lever 16 when the 2nd clamp is blockaded. When OFF, a **** cage, and the 2nd clamp 2 are blockaded, a lever 16 is contacted, a lever 16 moves, and, specifically, a microswitch 13 makes a microswitch 13 ON condition, when the 2nd clamp is in a release condition. The ON/OFF signal of this microswitch 13 is inputted into a controller 40. It is judged that there are no 1st and 2nd clamps in a zero when a microswitch SW5 (73) and SW6 (74) detect the slot prepared on the periphery of each cam. It is detected by the microswitch 14 that the wafer exchange lever 22 is in a zero. When a microswitch 14 serves as ON when a lever 22 is in a zero, and there is nothing at a zero, OFF comes and the ON/OFF signal of this microswitch 14 is inputted into a controller 40.

[0027] And as shown in drawing 12 , when all four above-mentioned points are YES(s), a motor is operated and the 1st and 2nd clamps are returned to a zero. Moreover, an abnormality lamp puts out the light by in No, BUSA's carrying out singing, and an abnormality lamp's lighting up, performing manual discharge, and pushing at least one reset switch among four above-mentioned points. After the 1st and 2nd clamps arrive at a zero, the 1st and 2nd clamps are equipped with two flexible tubes 48 and 49. The 1st and 2nd clamps 3 and 2 in this condition are in the condition that 2f faced mutually slot 3e which is in the condition which both opened wide, and was prepared for both, and 2e and 3f, as [show / in drawing 10]. And the slots 3f and 2f of a near side are equipped with the tube 49 in use, and the slots 3e and 2e by the side of the back are equipped with the intact tube 48 connected. And after blockading the 1st and 2nd clamps 3 as mentioned above, the wafer exchange lever 22 is pushed on a clamp side, and wafers are exchanged. By pushing the wafer exchange lever 22 on a clamp side, a wafer newer than the inside of the wafer cartridge 8 is taken out, and while push and a standby wafer are equipped with the used wafer with which push and a standby wafer were equipped with the standby wafer with which the cutting means 5 is equipped with a new wafer by the cutting means 5 in an operating location, a used wafer is contained in the used wafer housing 29. By then, CPU which constitutes the controller 40 which will shift to ** of the flow chart of drawing 13 if the initiation switch 52 of a panel 50 is pushed, and is shown in drawing 3 [whether the 1st and 2nd clamps have closed, whether a wafer is exchange settled, and] Whether the 1st and 2nd clamps are in a zero, whether a wafer exchange lever is in a zero, and whether the 1st and 2nd clamps have closed When the 2nd clamp is blockaded, it is detected by the lever 16 which contacts, and the microswitch 13 in which ON/OFF is carried out by this lever 16. When the 2nd clamp is in a release condition, OFF has come, when the 2nd clamp 2 is blockaded, a lever 16 is contacted, a lever 16 moves, and, specifically, a microswitch 13 makes a microswitch 13 ON condition. The ON/OFF signal of this microswitch 13 is inputted into a controller 40. If whether a wafer is exchange settled does push and a wafer exchange activity in the clamp direction for the wafer exchange lever 22, since the exchange lever 22 makes a microswitch 15 turn on once, it will be detected whether it was exchanged by ON signal from a microswitch 15. The ON/OFF signal of a microswitch 15 is inputted into a controller 40. Whether the 1st and 2nd clamps are in a zero detects with microswitches 5 and 6 as mentioned above.

[0028] And as shown in drawing 13 , in No, BUSA carries out singing and returns to ** of drawing 12 at least one of the four above-mentioned points. Moreover, when all the four above-mentioned points are YES (s), the working lamp 47 lights up and heating of a wafer is started. it judges whether a wafer current is beyond the set point after heating initiation of a wafer, and a wafer short-circuits this -- **** -- it is for judging. And when a wafer current is not below the set point (the electrical potential difference concerning shunt resistance beyond a predetermined value), after waiting for 0.3 seconds, it judges whether a wafer current is set point within the limits. When a wafer is a used thing, since resistance falls for the heat history of a resistor, this measures a wafer current, detects whether it is in a setting range (inside of tolerance) as compared with the wafer current set up beforehand, and, thereby, judges electrically whether a wafer is used. After BUSA carries out singing, suspending heating of a wafer, and the abnormality lamp in a wafer lighting up and pushing a reset switch when the above-mentioned wafer current is beyond the set point, and when an above-mentioned wafer current is not in a setting range (when the wafer has short-circuited) (when a wafer is used), it shifts to flow chart ** of drawing 12 . And heating of a wafer is continued when it is in a setting range (inside of tolerance) as compared with a wafer current. Heating of a wafer 6 is performed controlling the source 43 of a constant voltage by the Pulse-Density-Modulation signal computed based on the temperature detection output of the thermocouple 7 which is a wafer temperature detection means. and

in order to prevent superfluous heating of a wafer, when it judges whether the heating time of a wafer is predetermined within a time, and it judges whether a wafer current is below a predetermined value and the wafer has caused short circuit accident below the predetermined value that is, immediately, BUSA carries out singing, suspends heating of a wafer, and shifts to flow chart ** of drawing 12 . And if the temperature of a wafer reaches laying temperature, it shifts to flow chart ** of drawing 14 , and a motor operates, thereby, a gear 30, a gear 31, and cams 19 and 17 will rotate, a cutting means (wafer) will go up, and ****** by the side of cutting of a tube, retreat of the 1st clamp, descent of a cutting means (wafer), and the 1st clamp of the 2nd clamp will be performed.

[0029] If it explains concretely, when a cam 17 rotates in the direction of an arrow head, follower 5b of the cutting means 5 will slide the inside of cam-groove 17a first. From the condition that the zero O of a cam groove shown in drawing 9 and drawing 1111 at the beginning touched follower 5b, the point A of cam-groove 17a shown in drawing 9 and drawing 11 comes to contact follower 5b. And as shown in drawing 11 , gently-sloping, the cutting means 5 goes up and two flexible tubes are cut from the condition that the point A of cam-groove 17a shown in drawing 9 and drawing 11 contacts follower 5b in the meantime, until the point B of cam-groove 17a results in the condition of contacting follower 5b. If it explains using drawing 15 and drawing 16 R> 6, two tubes 48 and 49 are held by the 1st clamp 3 and the 2nd clamp 2, the tube parts 48a and 49a located between the 1st clamp 3 and the 2nd clamp 2 are formed, and the wafer 6 of a cutting means is located in the lower part. And as mentioned above, by rotation of a cam 17, when the cutting means 5 (wafer 6) goes up, as shown in drawing 16 , melting cutting of both is carried out in the tube parts 48a and 49a located between the 1st clamp 3 of two tubes, and the 2nd clamp 2.

[0030] And as shown in drawing 9 and drawing 11 , the condition that the cutting means 5 went up is maintained, and the edge from which Tubes 48a and 49a were cut is fully dissolved, until it results in the condition that the point C of cam-groove 17a contacts follower 5b from the condition that the point B of cam-groove 17a shown in drawing 9 contacts follower 5b. And as shown in drawing 9 and drawing 11 , the cutting means 5 descends gently-sloping, until the point E of cam-groove 17a results [from the condition that the point C of cam-groove 17a shown in drawing 9 and drawing 11 contacts follower 5b] in the condition of contacting follower 5b. Moreover, as shown in drawing 8 , when a cam 19 rotates in the direction of an arrow head, follower 18a prepared in the arm 18 for moving the 1st clamp slides the inside of cam-groove 19a. From the condition that the zero O of a cam groove shown in drawing 8 and drawing 11 at the beginning touched follower 18a, the point F of cam-groove 19a shown in drawing 8 and drawing 11 comes to contact follower 18a. As shown in the timing chart of drawing 11 , follower 18a results in cam-groove 19 a point F early a little rather than follower 5b of the cutting means 5 results in the point B of cam-groove 17a. And as shown in drawing 11 R> 1, gradually, the 1st clamp 3 retreats, will be in the condition which shows in drawing 17 R> 7, and will be in the condition that the tube parts 49a and 48a joined faced each other through the wafer 6, until the point G of cam-groove 19a results [from the condition that the point F of cam-groove 19a contacts follower 18a] in the condition contact follower 18a, as shown in drawing 8 R> 8 and drawing 11 . As shown in the timing chart of drawing 11 , this condition is maintained from the condition that the point G of cam-groove 19a contacts follower 18a until the point C of cam-groove 17a results in the condition of contacting follower 5b. And the condition of drawing 17 is maintained until the location of the 1st clamp results [from the condition that Point G contacts follower 18a] in the condition that the point H of cam-groove 19a contacts follower 18a. In addition, as the cutting means 5 is shown in drawing 9 and drawing 11 until the point E of cam-groove 17a results [from the condition that the point C of cam-groove 17a shown in drawing 9 and drawing 11 contacts follower 5b as mentioned above] in the condition of contacting follower 5b, it descends gently-sloping and the tube parts 48a and 49a joined contact.

[0031] And with the time of resulting in the condition which descent of the cutting means 5 ended, and the condition that the point E of cam-groove 17a contacts follower 5b, mostly, as shown in drawing 7 and drawing 11 , in other words, the 2nd clamp 2 performs ****** to coincidence at the 1st clamp side. As shown in drawing 7 and drawing 11 , specifically the point M of 17d of left laterals of cam-groove 17c Gradually until the point L of a left lateral results [from the condition of contacting the follower 20 for making the 2nd clamp 2 driving] in the condition of contacting a follower 20 the 2nd clamp 2 It moves to the 1st clamp 3 side, and the condition of having ******(ed) is maintained until the point K of 17d of crevices results [from the condition that the point LK of 17d of crevices of cam-groove 17c contacts a follower 20] in the condition of contacting a follower 20. By this ******, since both of the tube parts 48a and 49a stick certainly, they can make both junction a more positive thing. And gradually, the 2nd clamp 2 moves in the direction separated from the 1st clamp 3 side, and actuation of a motor stops it to this ******

until the point J of 17f of left laterals results [from the condition that the point K of 17d of crevices of cam-groove 17c contacts a follower 20] in the condition of contacting a follower 20.
[0032] Therefore, the 1st clamp 3 in the stopped location serves as location shifted like drawing 17 , as the location of the 2nd clamp 2 is shown in drawing 18 . And if wafer temperature is detected by the thermocouple and wafer temperature becomes below the set point as shown in the flow chart of drawing 14 R> 4, a run light will put out the light and BUSA will carry out singing. And as shown in drawing 18 , the junction activity of a tube is completed by opening the 1st clamp 2 and the 2nd clamp 3, and taking out a tube. Moreover, if it puts in another way until the point C of cam-groove 17a results in the condition of contacting follower 5b, from the condition that the point A of cam-groove 17a shown in drawing 7 and drawing 11 contacts follower 5b, although not indicated to the flow chart of drawing 14 It judges whether as shown in the flow chart of drawing 13 , a wafer is laying temperature after the cutting means 5 starts a rise also until it starts descent. It is desirable to control the source 43 of a constant voltage by the Pulse-Density-Modulation signal computed based on the temperature detection output of the thermocouple 7 which is a wafer temperature detection means, and to perform temperature control of a wafer. Since the heat of a wafer is absorbed with a tube and this falls when a wafer contacts the tubes 48 and 49 to cut even if a wafer reaches laying temperature once, it is for the compensation ****. The amendment temperature signal b which amended the temperature detection signal a from the thermocouple whose heating control circuit 55 in drawing 4 is the temperature detection means 7 with the PID amendment vessel 56 (proportionality and differential / integral amendment machine 1) which is the amendment wafer temperature calculation section 56, and was amended especially as mentioned above shall be outputted, and it is the amendment Formula 1b=1/K-a- (1+K1 and T-da/dt) ... (1)
If it shall be alike and correction value shall be computed more, since the amendment temperature signal b will have amended the time lag until the actual temperature of the thermocouple which is a temperature detection signal falls by the fall of the temperature of a wafer in K1 and T-da/dt and the fall temperature of an actual wafer is detected correctly, temperature control of a wafer can be performed early [correspondence].
[0033]
[Effect of the Invention] The flexible tube sterile junction equipment of this invention is equipment for joining a flexible tube in sterile. This equipment The 1st clamp and the 2nd clamp which hold at least two flexible tubes in the parallel condition, The cutting means for cutting said flexible tube between this 1st clamp and the 2nd clamp, It has the migration means to which either [at least] said 1st clamp or said 2nd clamp is moved so that both the edges to which the flexible tube cut by this cutting means is joined may stick. A wafer for said cutting means to carry out melting cutting of said flexible tube, It has the source of a constant voltage, wafer temperature detection means, and wafer heating control means for heating this wafer. Said wafer heating control means Based on the output of said wafer temperature detection means, it has the Pulse-Density-Modulation signal output part computed, and said source of a constant voltage is controlled by this Pulse-Density-Modulation signal. By using the source of a constant voltage, and a Pulse-Density-Modulation signal circuit especially, power consumption can be made small, further, by controlling the source of a constant voltage by the Pulse-Density-Modulation signal, temperature control of a wafer for heating melting to cut a flexible tube can be performed certainly, and a positive tube can be joined.

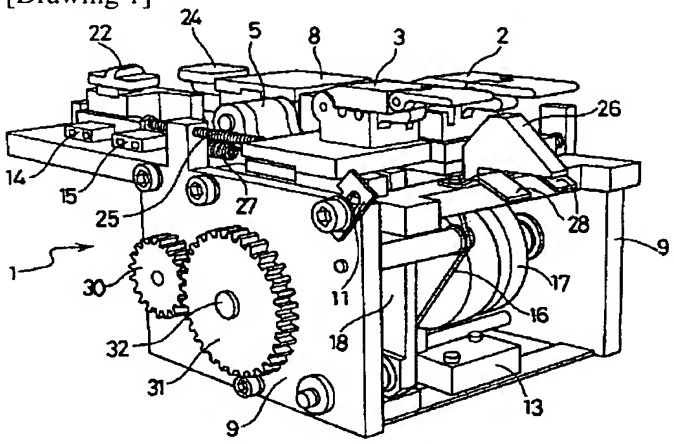
[Translation done.]

* NOTICES *

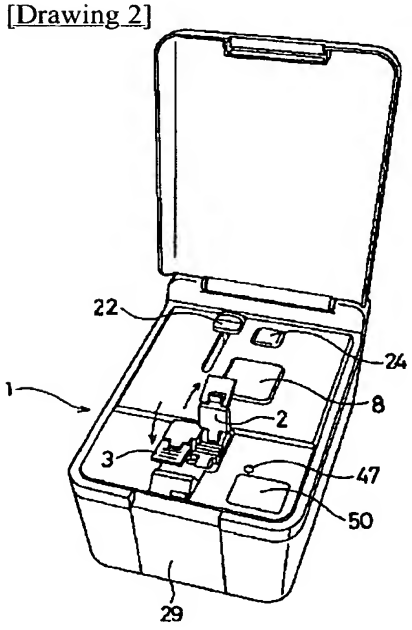
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

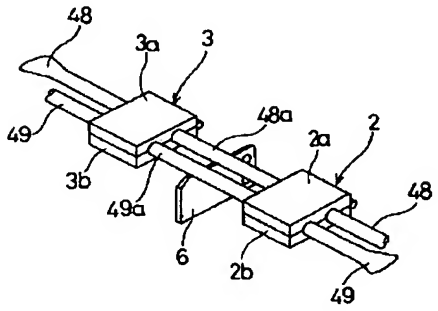
[Drawing 1]



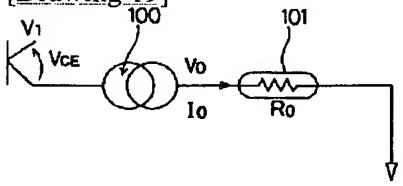
[Drawing 2]



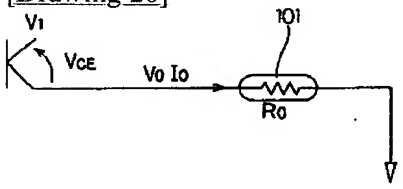
[Drawing 15]



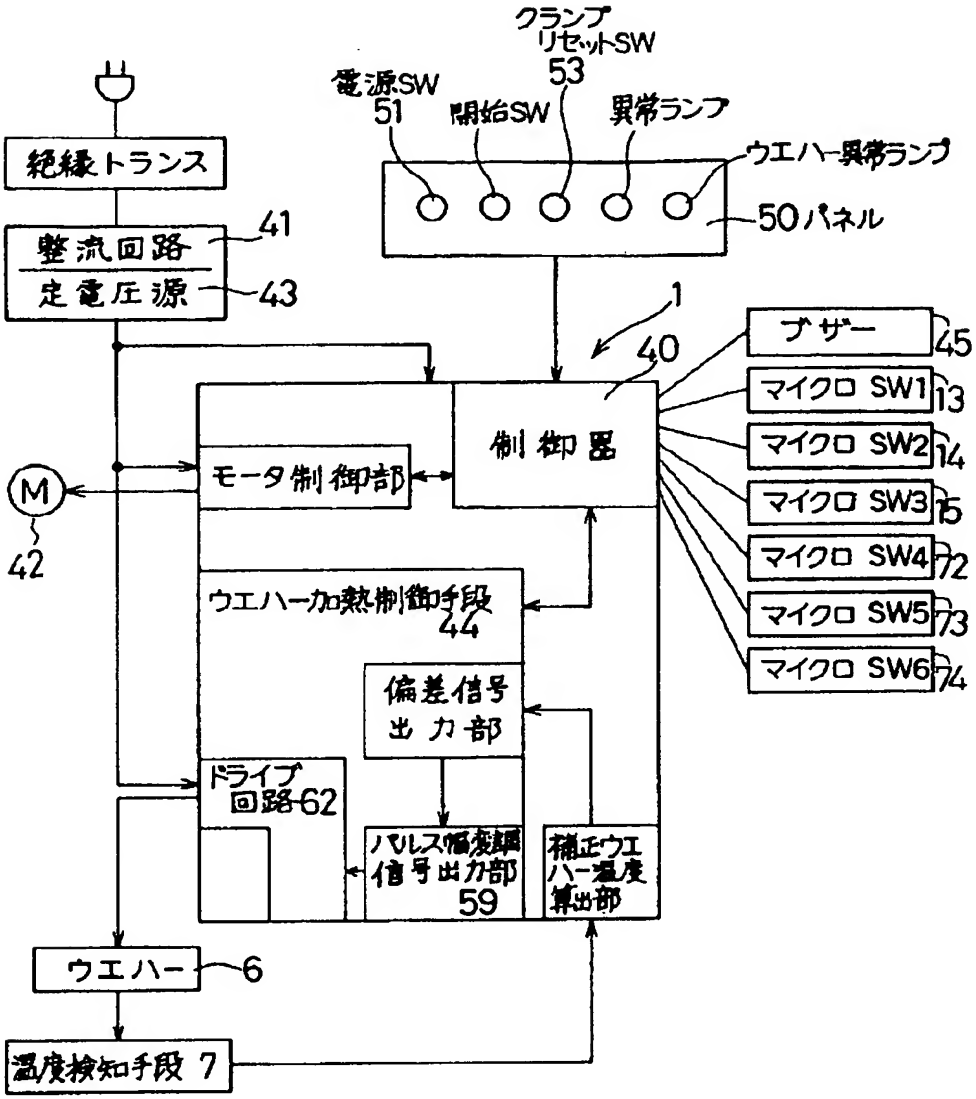
[Drawing 19]



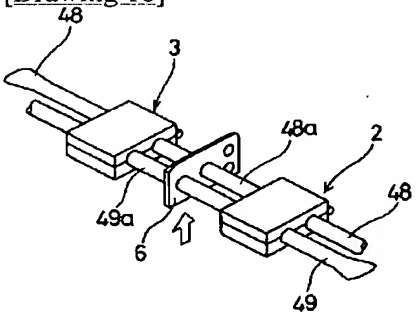
[Drawing 20]



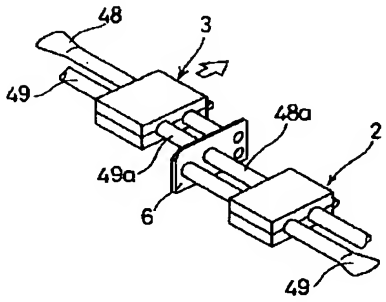
[Drawing 3]



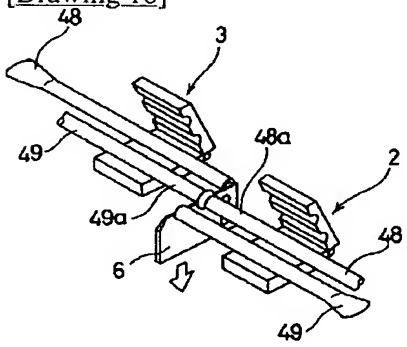
[Drawing 16]



[Drawing 17]



[Drawing 18]



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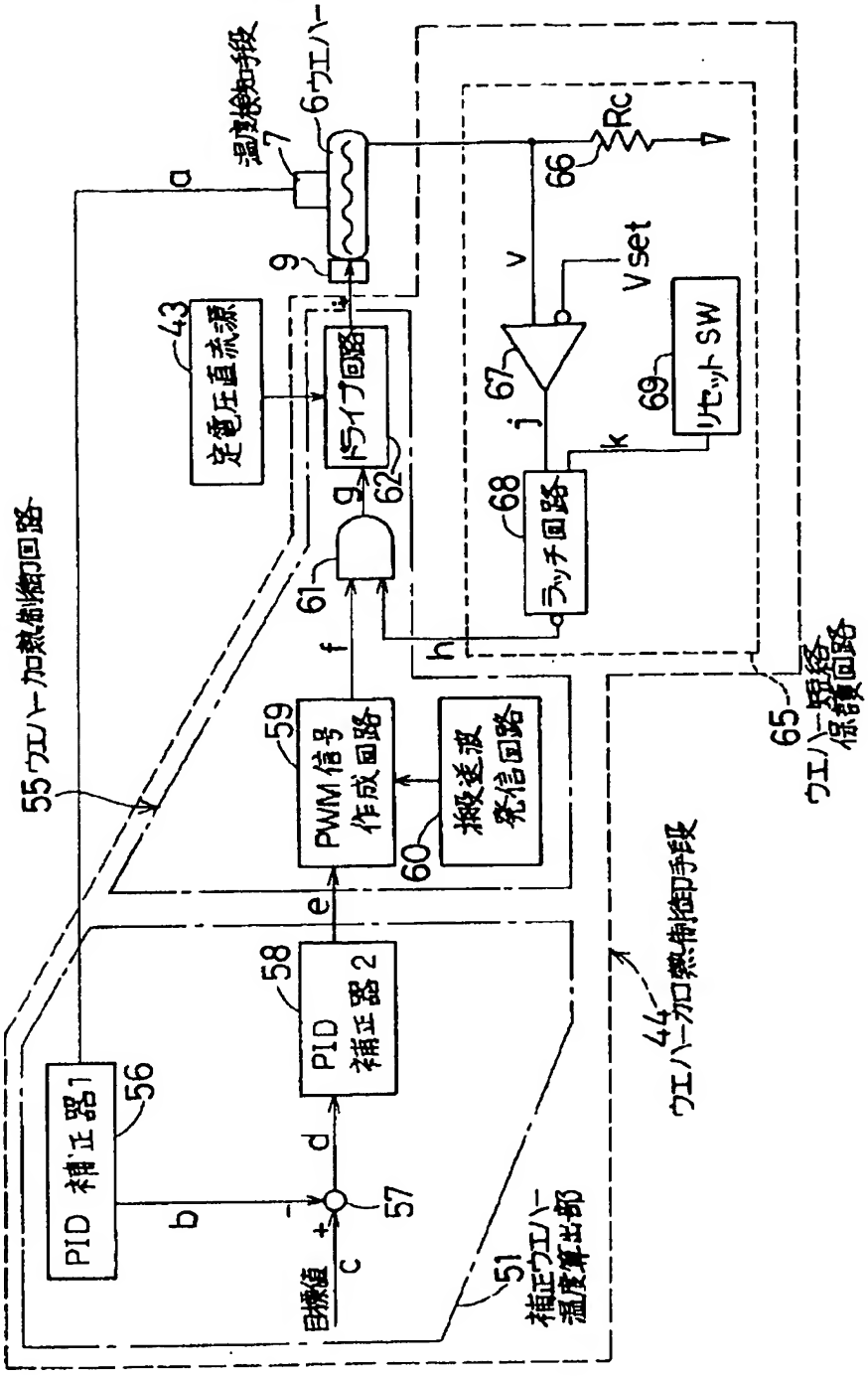
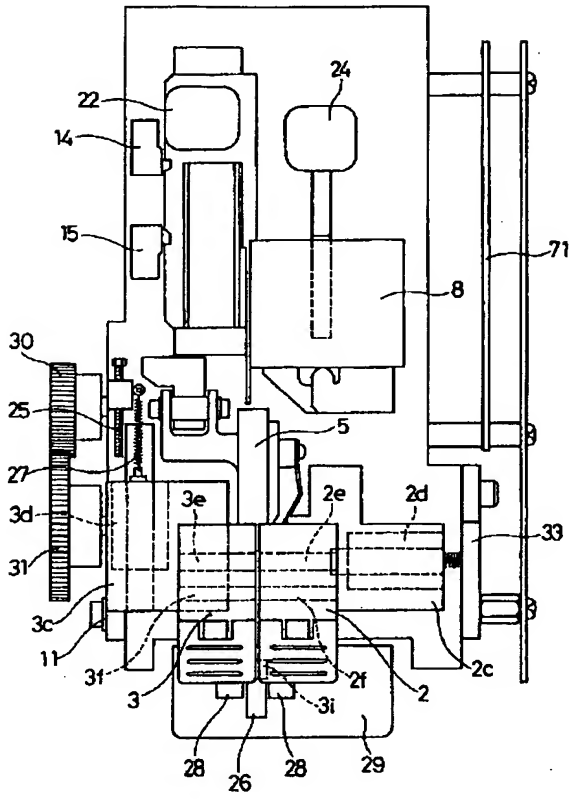

温度検知手段
6ウエハー
7
Rc
66
a
9
v
Vset
43
定電圧直流源
ドライブ回路
62
67
69
リセットSW
j
k
g
68
ラッチ回路
61
f
h
55ウエハー加熱制御回路
59
PWM信号作成回路
搬送波発信回路
60
65
ウエハー温度保償回路
e
58
PID補正器2
44
ウエハー加熱制御手段
56
PID補正器1
d
b
57
c
目標値
51
補正ウエハー温度算出部

[Drawing 5]



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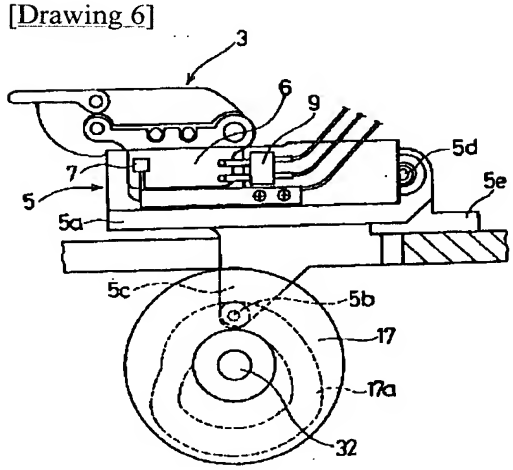
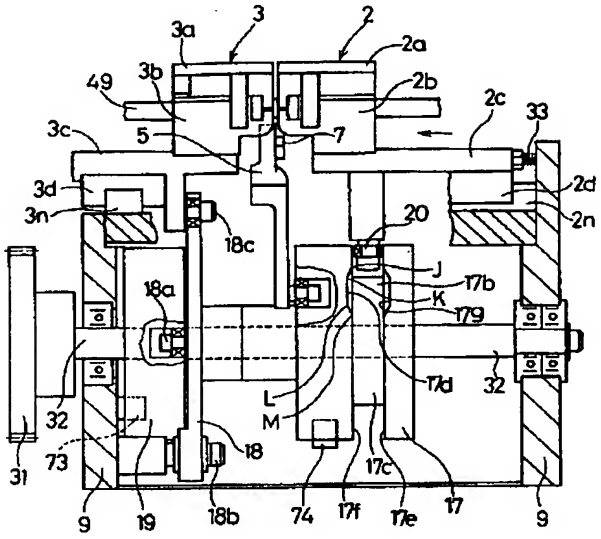
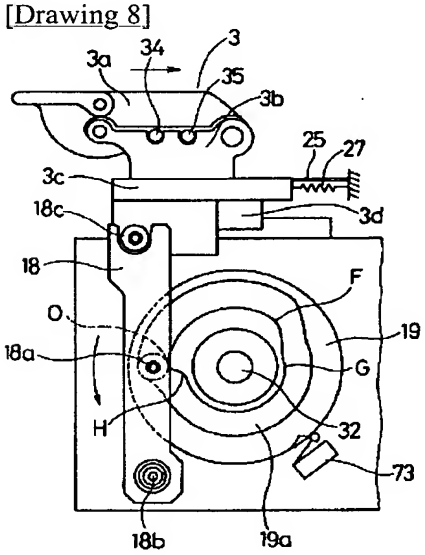


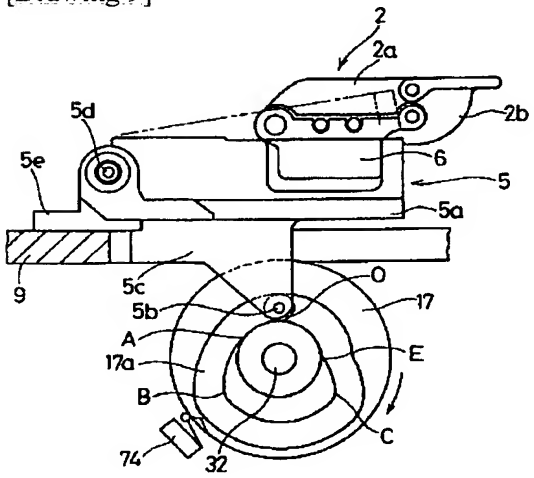
[Drawing 7]



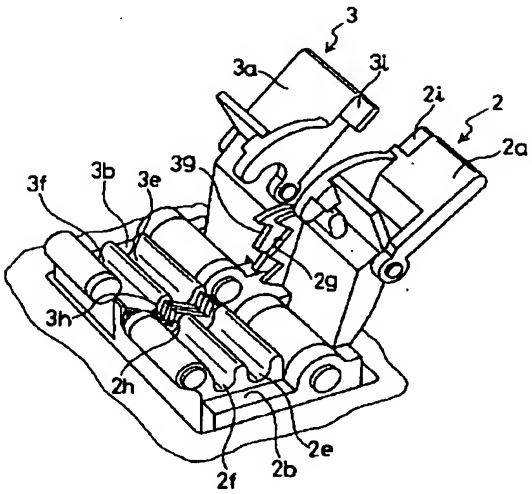
[Drawing 8]



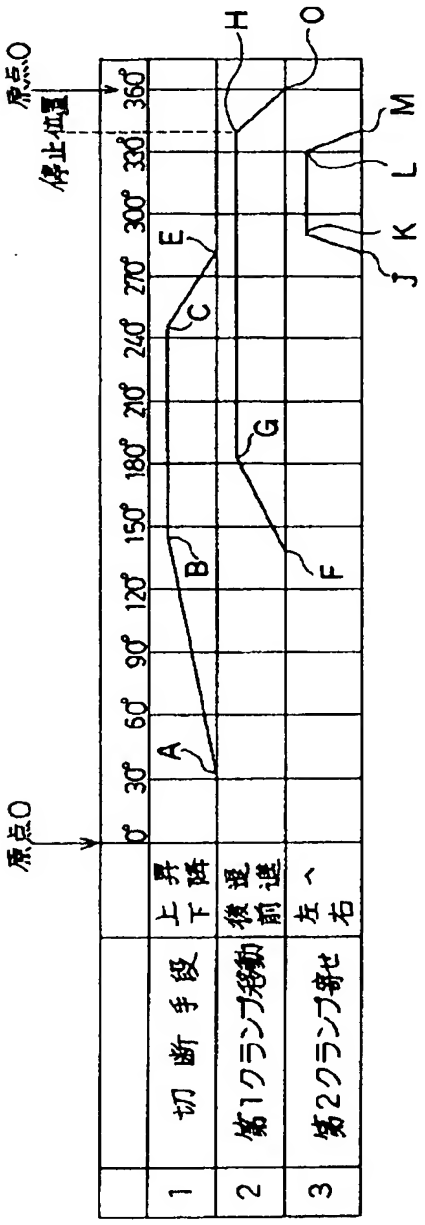
[Drawing 9]



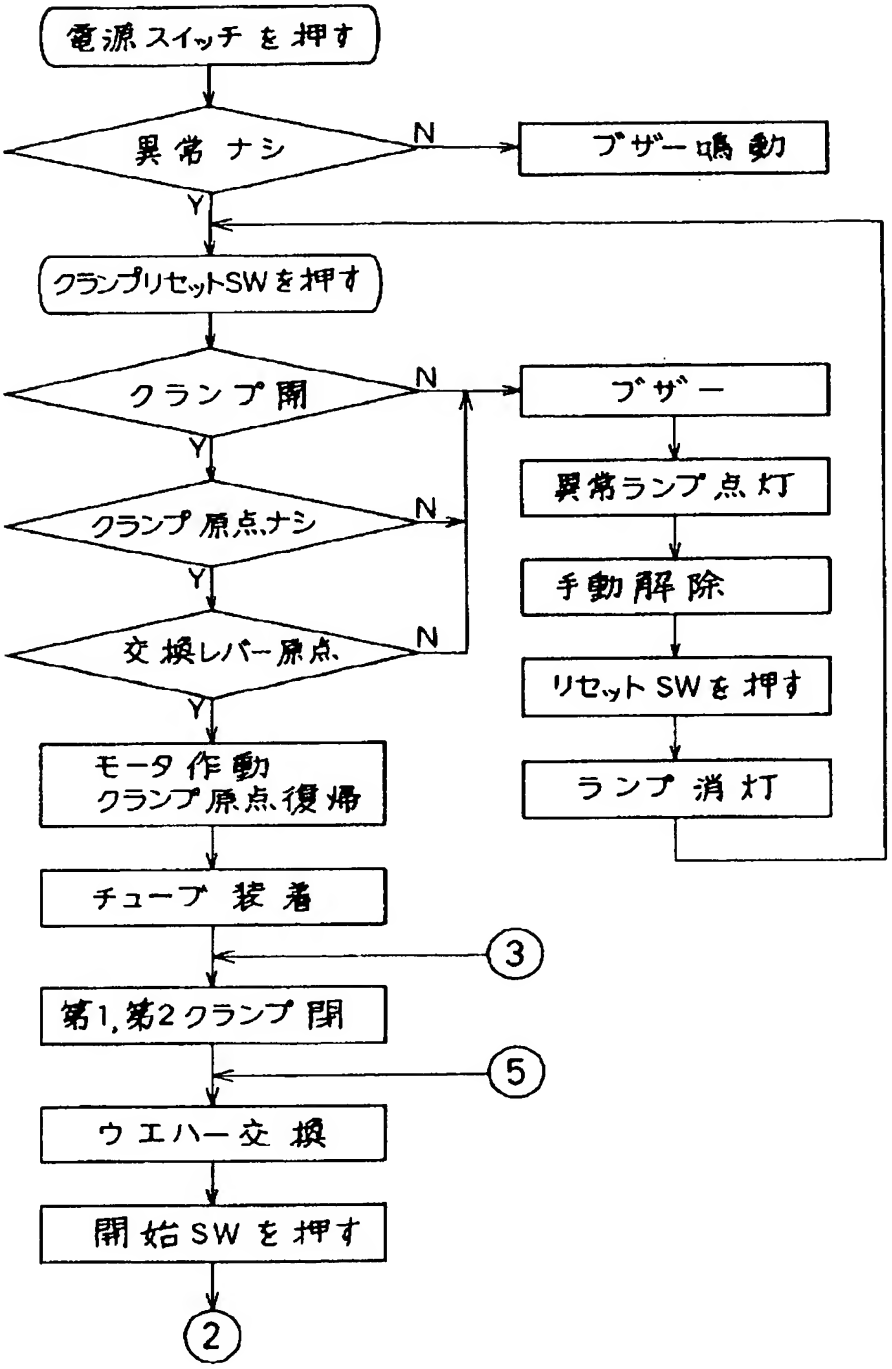
[Drawing 10]



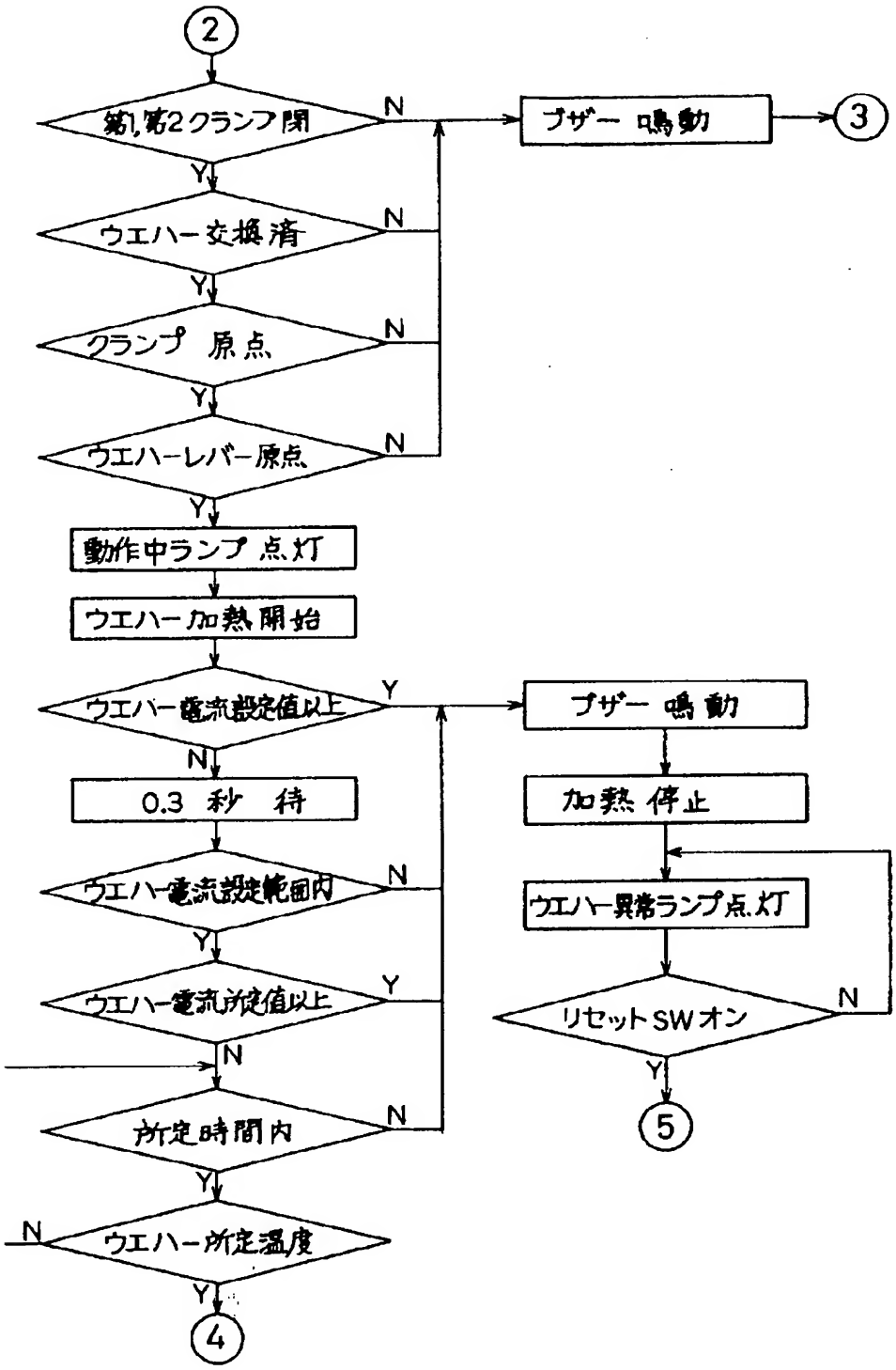
[Drawing 11]


原点O
停止位置
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°
360°
原点O
A
B
C
E
G
H
O
F
J
K
L
M
1
切断手段
上昇下降
2
第1クランプ移動
後退前進
3
第2クランプ寄せ
左へ右

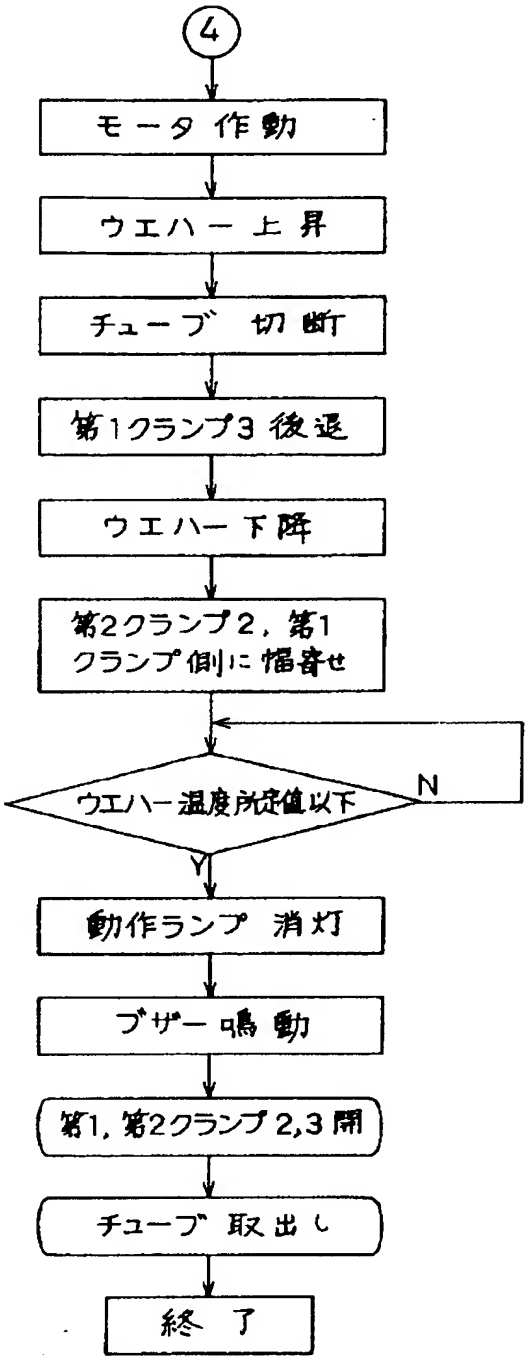
[Drawing 12]


電源スイッチを押す
異常ナシ
N
ブザー鳴動
Y
クランプリセットSWを押す
クランプ閉
N
ブザー
Y
異常ランプ点灯
クランプ原点ナシ
N
手動解除
Y
交換レバー原点
N
リセットSWを押す
Y
モータ作動
クランプ原点復帰
ランプ消灯
チューブ装着
3
第1,第2クランプ閉
5
ウエハー交換
開始SWを押す
2

[Drawing 13]


2
第1,第2クランプ閉
N
ブザー 鳴動
3
Y
ウエハー交換済
N
Y
クランプ 原点
N
Y
ウエハーレバー原点
N
Y
動作中ランプ 点灯
ウエハー加熱開始
ウエハー電流設定値以上
Y
ブザー 鳴動
N
0.3 秒 待
加熱 停止
ウエハー電流設定範囲内
N
ウエハー異常ランプ点灯
Y
ウエハー電流所定値以上
Y
リセットSWオン
N
N
所定時間内
N
Y
N
ウエハー所定温度
Y
5
4

[Drawing 14]



[Translation done.]

* NOTICES *

CORRECTION OR AMENDMENT

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[Section partition] The 2nd partition of the 1st section
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[Filing Date] August 31, Heisei 11 (1999. 8.31)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Whole sentence
[Method of Amendment] Modification
[Proposed Amendment]
[Document Name] Specification
[Title of the Invention] Flexible tube sterile junction equipment
[Claim(s)]
[Claim 1] It is flexible tube sterile junction equipment which is equipped with the following, and said wafer heating control means has the Pulse-Density-Modulation signal output part computed based on the output of said wafer temperature detection means, and is characterized by being what controls said source of a constant voltage by this Pulse-Density-Modulation signal. It is the 1st clamp and the 2nd clamp to which it is equipment for joining a flexible tube in sterile, and this equipment holds a tube. It is a wafer to have a cutting means for cutting said flexible tube between this 1st clamp and the 2nd clamp, and for said cutting means carry out melting cutting of the flexible tube. The source of a constant voltage for heating this wafer A wafer temperature detection means and a wafer heating control means
[Claim 2] Flexible tube sterile junction equipment according to claim 1 characterized by providing the following Said flexible tube sterile junction equipment is the 1st clamp and the 2nd clamp which hold at least two flexible tubes in the parallel condition. The cutting means for cutting said flexible tube between this 1st clamp and the 2nd clamp The migration means to which either [at least] said 1st clamp or said 2nd clamp is moved so that both the edges to which the flexible tube cut by this cutting means is joined may stick
[Claim 3] It is flexible tube sterile junction equipment according to claim 1 or 2 which is that to which said

wafer heating control means has the deflection signal output part which outputs the deflection signal of the amendment wafer temperature calculation section, the amendment temperature computed by this calculation section, and whenever [purpose stoving temperature / of said wafer] based on the output of said wafer temperature detection means, and said Pulse-Density-Modulation signal output part outputs a Pulse-Density-Modulation signal based on this deflection signal.
[Claim 4] Said wafer heating control means is flexible tube sterile junction equipment according to claim 1 to 3 which has the wafer short circuit protection network.
[Claim 5] It is flexible tube sterile junction equipment according to claim 4 with which said wafer short circuit protection network has the short circuit detection section of said wafer, and the pulse-width-modulation signal-control section which controls an inflow in said drive circuit of the pulse-width-modulation signal from said pulse-width-modulation signal output part based on the detection signal of this short circuit detection section by said wafer heating control means having the drive circuit for controlling said source of a constant voltage by this pulse-width-modulation signal.
[Claim 6] Said amendment wafer temperature calculation section is flexible tube sterile junction equipment according to claim 3 which has proportionality, the integral, and the differential correction circuit.
[Claim 7] Said deflection signal output part is flexible tube sterile junction equipment according to claim 3 which has proportionality, the integral, and the differential correction circuit.
[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention carries out heating fusion of at least two flexible tubes, and relates to the flexible tube sterile junction equipment for connecting in sterile.
[0002]
[Description of the Prior Art] At the time of tube connection of the blood collecting bag in a transfusion system and a constituent-of-blood bag, and exchange of the dialysing fluid bag in continuous ambulatory PD (CAPD), and a waste fluid bag, it is necessary to connect a tube in sterile. There are some which are shown in JP,61-30582,B as equipment which makes sterile connection of such a tube. The equipment shown in this JP,61-30582,B is a tube contact which carries out heating fusion of the tube and is connected. It has a cutting means for cutting a flexible tube between the 1st clamp and the 2nd clamp which hold two flexible tubes which should be connected in the parallel condition, and the 1st clamp and the 2nd clamp, and the migration means to which either [at least] the 1st clamp or the 2nd clamp is moved so that both the edges to which the flexible tube cut by the cutting means is joined may stick.
[0003] And the cutting means has the wafer for carrying out melting cutting of the flexible tube, and the power source for heating a wafer. As a power source for heating a wafer, the constant current source is used as shown in JP,59-64034,A. And the approach of predicting the temperature of a wafer from resistance is used for the temperature control of a wafer using the resistance temperature change of a resistor.
[0004]
[Problem(s) to be Solved by the Invention] However, by the approach the temperature control of a wafer predicts the temperature of a wafer from resistance using the resistance temperature change of a resistor using a constant current source, it actually has the trouble that it is difficult to perform positive temperature control since the temperature of a wafer is measured and it does not control as shown in JP,59-64034,A. Furthermore, in the heating circuit using a constant current source, since loss of a drive circuit was large, there was also a trouble that power consumption was large. Then, the purpose of this invention can perform certainly temperature control of a wafer for heating melting to cut a flexible tube, and offers flexible tube sterile junction equipment with little power consumption further.
[0005]
[Means for Solving the Problem] It is equipment for joining a flexible tube in sterile which attains the above-mentioned purpose. This equipment It has a cutting means for cutting said flexible tube between the 1st clamp and the 2nd clamp holding a tube, and this 1st clamp and the 2nd clamp. Said cutting means The source of a constant voltage for heating the wafer and this wafer for carrying out melting cutting of the flexible tube, It has a wafer temperature detection means and a wafer heating control means. Said wafer heating control means It is flexible tube sterile junction equipment which is what has the Pulse-Density-Modulation signal output part computed based on the output of said wafer temperature detection means, and controls said source of a constant voltage by this Pulse-Density-Modulation signal. It is equipment for joining a flexible tube in sterile which attains the above-mentioned purpose. Moreover, this equipment The 1st clamp and the 2nd clamp which hold at least two flexible tubes in the parallel condition, The cutting means for cutting said flexible tube between this 1st clamp and the 2nd clamp, It has the migration means to

which either [at least] said 1st clamp or said 2nd clamp is moved so that both the edges to which the flexible tube cut by this cutting means is joined may stick. A wafer for said cutting means to carry out melting cutting of said flexible tube, It has the source of a constant voltage, wafer temperature detection means, and wafer heating control means for heating this wafer. Said wafer heating control means It is flexible tube sterile junction equipment which is what has the Pulse-Density-Modulation signal output part computed based on the output of said wafer temperature detection means, and controls said source of a constant voltage by this Pulse-Density-Modulation signal.

[0006] And said wafer heating control means has the deflection signal output part which outputs the deflection signal of the amendment wafer temperature calculation section, the amendment temperature computed by this calculation section, and whenever [purpose stoving temperature / of said wafer] based on the output of said wafer temperature detection means, and, as for said Pulse-Density-Modulation signal output part, it is desirable that it is what outputs a Pulse-Density-Modulation signal based on this deflection signal. Furthermore, as for said wafer heating control means, it is desirable to have the wafer short circuit protection network. Moreover, said wafer heating control means has the drive circuit for controlling said source of a constant voltage by this pulse-width-modulation signal, and, as for said wafer short circuit protection network, it is desirable to have the short circuit detection section of said wafer and the pulse-width-modulation signal-control section which controls an inflow in said drive circuit of the pulse-width-modulation signal from said pulse-width-modulation signal output part based on the detection signal of this short circuit detection section. Moreover, as for said amendment wafer temperature calculation section, it is desirable to have proportionality, the integral, and the differential correction circuit. Furthermore, as for said deflection signal output part, it is desirable to have proportionality, the integral, and the differential correction circuit. And as for said wafer temperature detection means, it is desirable that they are a thermocouple or a resistance bulb. Furthermore, as for said wafer temperature detection means, it is desirable that they are a sheath form thermocouple or a resistance bulb.

[0007] Then, the flexible tube sterile junction equipment of this invention is explained with reference to a drawing. The 1st clamp 3 and the 2nd clamp 2 which this flexible tube sterile junction equipment 1 is equipment for joining a flexible tube in sterile, and hold at least two flexible tubes in the parallel condition, The cutting means 5 for cutting the flexible tubes 48 and 49 between the 1st clamp 3 and the 2nd clamp 2, It has the migration means to which either [at least] the 1st clamp 3 or the 2nd clamp 2 is moved so that both edges 48a to which the flexible tubes 48 and 49 cut by the cutting means 5 are joined, and 49a may stick. The wafer 6 for the cutting means 5 to carry out melting cutting of the flexible tubes 48 and 49, It has the source 43 of a constant voltage, the wafer temperature detection means 7, and the wafer heating control means 44 for heating a wafer 6. The wafer heating control means 44 Based on the output of the wafer temperature detection means 7, it has the Pulse-Density-Modulation signal output part 59 computed, and the source 43 of a constant voltage is controlled by the Pulse-Density-Modulation signal.

[0008] Drawing 1 is the perspective view of one example of the flexible tube sterile junction equipment of this invention, drawing 2 is the perspective view showing the condition contained in the case the sterile junction equipment shown in drawing 1, drawing 3 is the block diagram showing an example of the electrical circuit used for the sterile junction equipment of this invention, and drawing 4 is the electrical circuit block diagram showing an example of the wafer heating control means of the electrical circuit of the sterile junction equipment of this invention. Drawing 5 is the plan of one example of the flexible tube sterile junction equipment of this invention.

[0009] Next, the wafer heating control means indicated to drawing 4 is explained. What has the metal plate bent as a wafer 6 so that it might face each other, the insulating layer formed in the inside of this metal plate, the resistor formed so that the above-mentioned metal plate might not be contacted in this insulating layer, and the terminal for energization prepared in the both ends of this resistor is used suitably. And since a resistor generates heat by energization, generation of heat of a resistor is conducted to a metal plate, and the whole wafer generates heat by energization. And resistance changes with generation of heat according [a resistor] to energization. Therefore, the source of a constant voltage is only used and temperature control of enough wafers cannot be performed only by adjusting the electric power supply to a wafer. So, with the sterile junction equipment 1 of this example, it has the wafer heating control means.

[0010] As shown in drawing 4, as for the wafer heating control means 44, it is desirable to have the wafer heating control circuit 55 and the amendment wafer temperature calculation section 51, and to have the wafer short circuit protection network 65 further, as shown in drawing 4. The wafer heating control circuit 55 has the Pulse-Density-Modulation signal output part 59 computed based on the output from the temperature detection means 7, and controls the source 43 of a constant voltage by the Pulse-Density-

Modulation signal. Having the deflection signal output part 57 which outputs the deflection signal of the amendment temperature specifically computed by the amendment wafer temperature calculation section 56 which computes amendment wafer temperature, and the calculation section based on the output of the wafer temperature detection means 7, and whenever [purpose stoving temperature / of a wafer], the Pulse-Density-Modulation signal output part 59 outputs a Pulse-Density-Modulation signal based on a deflection signal. As a temperature detection means 7, it is desirable that they are a thermocouple or a resistance bulb. More preferably, it is a sheath form thermocouple or a resistance bulb, and a sheath form thermocouple is desirable especially.

[0011] If the heating control means 44 is more concretely explained using drawing 4, the temperature detection signal a from the thermocouple which is the temperature detection means 7 will be inputted into the PID amendment machine 56 (proportionality and differential / integral amendment machine 1) of the amendment wafer temperature calculation section 51, and the amended amendment temperature signal b will be outputted. With this PID amendment machine 56, it is a formula 1, for example.

b=1-/K-a- (1+K1 and T-da/dt) ... (1)

It is alike and correction value is computed more. K is the coupling coefficient of a wafer and a thermocouple, K1 is a correction factor resulting from the flexible tube cut, and T is the thermal time constant of a thermocouple. The purpose which performs such amendment is to perform [performing amendment (K) based on the heat-conduction loss between a wafer and a thermocouple, and] amendment in consideration of the thermal time constant (T) of a thermocouple. And as shown in a formula 1, the amendment temperature signals1/K are highly computed by K1 and T-da/dt, while wafer temperature is rising from the surveyed wafer temperature signal a, since b is a constant. The temperature which a thermocouple detects is the internal temperature of a thermocouple, and has delay to the skin temperature of a wafer. However, since the delay of a thermocouple is approximated to first-order lag, it considers as a time constant T and the primary progress operation of a time constant T is conversely performed as a correction function by performing the above-mentioned amendment, wafer skin temperature is correctly [without a time lag] computable.

[0012] Moreover, exact wafer skin temperature is correctly [without a time lag] computable by performing amendment as shown in a formula 1 also at the time of wafer temperature descent. And it will become a formula 2 if a formula 1 is rewritten in consideration of a sampling time (**t).

b(t+**t) = 1-/K-a (t+**t) and {1+K1.T/**t-[a (t+)

**t-a (t)]} ... (2)

Thus, the amendment temperature signal b computed is compared with the target wafer temperature signal c, and the deflection signal d is outputted by the deflection signal output part 57. This deflection signal d is inputted into the PID amendment machine 2 designed by the suitable transfer function in order to raise the responsibility of a control system, and it is outputted as an amendment deflection signal e. This amendment deflection signal e is inputted into the Pulse-Density-Modulation signal output part (PWM signal creation circuit) 59. The PWM signal creation circuit 59 synchronizes with the predetermined frequency created by the above-mentioned amendment deflection signal e and the above-mentioned subcarrier oscillator circuit 60, and outputs the signal (pulse train signal which carried out the PWM modulation) f of the pulse width proportional to the amendment deflection signal e. This pulse train signal f passes along a gate circuit 61, and flows into the drive circuit 62. The drive circuit 62 is constituted by a transistor, a thyristor, etc. which are a solid-state-switching component, inputted pulse train signal g acts as switching and a timing signal, and only when pulse train signal g is in the condition of H, the source of a constant voltage and a wafer are connected. Connection between the drive circuit 62 and a wafer 6 is made with the connection terminal 39. The source 43 of a constant voltage and a wafer 6 are intermittently connected based on pulse train signal g, and a wafer is controlled by the wafer temperature made into the purpose.

[0013] And when the outline of the heating circuit in the case of constant-current system comes to be shown in drawing 19 and loss of the heating circuit of constant-current system is searched for, loss (Wo') is Wo'= (Vi-Vo) Io and is Wo'= [Vce+ {(Vi-Vce) -Vo}] and Io. It is set to (A). Moreover, the outline of the heating circuit in the case of PWM comes to be shown in drawing 20, and loss (Wo) of a drive circuit is,

It is Wo=Vo/Vi-Vce-Io+W1 (B),

W1 is the switching loss of the transistor which constitutes a drive circuit. And generally a comparison of Wo and Wo' materializes the following relation in B type.

Vo/Vi-Vce-Io>W1

Next, generally in A type, the following relation is realized.

Vce<<(Vi-Vce)-Vo

If this compares the 1st item of A type and B type, and the 2nd item,
Vo/Vi-Vce-Io<Vce-Io
W1<(Vi-Vce)-Vo}, Io
Therefore, it becomes Wo<Wo' and the PWM of power consumption is smaller compared with constant-current system.
[0014] Next, a wafer short circuit protection network is explained using drawing 4. In a normal state, since the signal j from a comparator 67 is not inputted into a latch circuit 68, the latch circuit 68 is always outputting the signal of H to a gate circuit 61 (AND circuit). For this reason, a gate circuit outputs Signal g to the drive circuit 62 according to ON/OFF (H/L) of the PWM signal f. And as shown in drawing 4, the shunt resistance 66 is connected electrically and the electrical potential difference V of the shunt resistance 66 is compared with the wafer 6 by the comparator 67 with the programmed voltage Vset. In a normal state, since it is lower than a programmed voltage Vset, Signal j is not outputted for the electrical potential difference V during shunt resistance from a comparator 67. However, if a wafer 6 short-circuits, since the current beyond a convention will flow to the shunt resistance 66, if the electrical potential difference V of the shunt resistance 66 rises and it becomes large from a programmed voltage Vset, Signal j will be outputted to a latch circuit 68 from a comparator 67. The latch circuit 68 has the function to hold the condition, once Signal j is inputted. For this reason, once Signal j is inputted, the signal of L will always be outputted to a gate circuit 61 (AND circuit). For this reason, the signal g based on the PWM signal f is no longer outputted to the drive circuit 62, and a circuit is protected from a gate circuit 61. And if a reset switch 69 is pushed after exchanging the wafer which caused short circuit accident, a latch circuit 68 will output the signal of H to a gate circuit 61 (AND circuit). Once reset-signal k is inputted, a latch circuit 68 will hold the condition and will return to a normal state.
[0015] Next, the device of the sterile whole junction equipment 1 is explained. This sterile junction equipment 1 has the 1st clamp 3 and the 2nd clamp 2 which hold at least two flexible tubes in the parallel condition, as shown in drawing 1, drawing 2, drawing 5, and drawing 10. By rotation of the gear 30 rotated by actuation of a motor, the gear 31 rotated by rotation of a gear 30, and a gear 31 The arm 18 for a drive for moving the prevention member 11 for preventing shakiness by the home position of the frame 9 to which the both ends of the shaft 32 to rotate and a shaft were fixed pivotable, and the 1st clamp 3, microswitches 13, 14, and 15, and the 1st clamp 3, and the 1st clamp 3 Shakiness of the cam 17 for making the cam 19, the cutting means 5, the cutting means 5, and the 2nd clamp for making it move drive, the press member 33 which presses the 2nd clamp 2 to the 1st clamp side, the specification-part material 25 which regulates the retreat location of the 1st clamp 3, and the 1st clamp 3 The induction member 26 for guiding the spring member 27 for preventing, the wafer exchange lever 22, the wafer cartridge 8, the wafer cartridge exchange lever 24, the used wafer housing grasping member 28, and a used wafer to a housing, the used wafer housing 29, and a control panel 50 It has.
[0016] And it is characterized by equipping this sterile junction equipment 1 with the following. The 1st clamp migration device to which the 1st clamp 3 is moved so that both edges 48a to which the flexible tubes 48 and 49 cut by the cutting means 5 are joined, and 49a may face each other The locomotive function for making a tubeside move the cutting means 5 (to upper part), and making it move in the direction (caudad) again separated from a tube after cutting The 2nd clamp migration device moved in the direction which approaches and estranges the 2nd clamp 2 to the 1st clamp 3 It is what makes it move to a cutting means drive up perpendicularly to the shaft of two tubes, and moves the cutting means 5 to it caudad after tube cutting. The 1st clamp migration device It is what moves the 1st clamp 3 in the rectangular direction in the level condition to the shaft of two tubes (concrete -- back) after tube cutting. the 2nd clamp migration device The 2nd clamp 2 is moved in parallel very only in the level condition to the shaft of two tubes so that the 1st clamp side may be approached.
[0017] Then, the 1st and 2nd clamps 3 and 2 are explained. The 1st and 2nd clamps 3 and 2 are constituted as shown in drawing 1, drawing 5, drawing 7, and drawing 10. Specifically, the 1st clamp 3 has base 3b, covering 3a attached in this base 3b pivotable, and clamp standing-ways 3c to which base 3b was fixed, as shown in drawing 10. And this clamp standing-ways 3c is being fixed to the linear table. The linear table is constituted by 3n of rail members prepared in the lower part of 3d of movable carriages fixed to the inferior surface of tongue of clamp standing-ways 3c, and 3d of movable carriages. And on this linear table, to the shaft of the tubes 48 and 49 to join, there is no distortion and the 1st clamp 3 is moved so that a perpendicular direction and both the edges to which in other words the cut flexible tube is joined may face each other. Therefore, the 1st clamp migration device is constituted from sterile junction equipment 1 of this example by the above-mentioned linear table, a motor, a gear 30, the gear 31, the shaft 32, the arm 18 for a

drive, and the cam 19. And with this junction equipment 1, as shown in drawing 1 and drawing 5, the spring member 27 which connects the back of 1st clamp standing-ways 3c and the frame of junction equipment 1 is formed, the 1st clamp 3 is in the condition of always having been pulled back, and shakiness of the 1st clamp 3 (correctly 1st clamp standing-ways 3c) is made into few things. Moreover, as shown in drawing 1 and drawing 5, the prevention member 11 for preventing shakiness of the 1st clamp 3 in the tube stowed position (location in the condition that in other words the 1st clamp came out to the foremost) of the 1st clamp 3 is being fixed to the side face of a frame 9. Therefore, the 1st clamp 3 is in the condition back pulled by the spring member 27, i.e., the condition which does not have shakiness in a back side, and shakes and can move [at a tube stowed position] no longer ahead from it by the prevention member in the front. Therefore, the 1st clamp 3 consists of tube stowed positions so that there may be no shakiness. Moreover, as shown in junction equipment 1 at drawing 1 and drawing 5, the specification-part material 25 which regulates the maximum migration location behind the 1st clamp 3 (correctly 1st clamp standing-ways 3c) is formed.

[0018] The 2nd clamp 2 has clamp standing-ways 2c by which covering 2a attached pivotable and base 2b were fixed to base 2b and this base 2b, as shown in drawing 5, drawing 7, and drawing 10. And this clamp standing-ways 2c is being fixed to the linear table. The linear table is constituted by 2n of rail members prepared in the lower part of 2d of movable carriages fixed to the inferior surface of tongue of clamp standing-ways 2c, and 2d of movable carriages. And on this linear table, to the shaft of the tubes 48 and 49 to join, the 2nd clamp 2 does not have distortion only in an parallel direction and the direction which approaches and estranges the 2nd clamp 2 to the 1st clamp 3, and, in other words, is moved to it.

[0019] Moreover, as shown in drawing 5 and drawing 7, the press member 33 is formed between the frame of junction equipment 1, and clamp standing-ways 2c, and the 2nd clamp 2 (correctly 2nd clamp standing-ways 2c) is always pushed on the 1st clamp side. As a press member, a spring member is used suitably. And when the weak thing is used and the thrust of the press member 33 grasps a flexible tube from the repulsive force of a flexible tube when grasping as two flexible tubes 48 and 49 were crushed by the 1st and 2nd clamps 3 and 2, this press member 33 is constituted so that the 2nd clamp 2 may move in the direction estranged a little from the 1st clamp 3. Therefore, the 2nd clamp migration device is constituted from sterile junction equipment 1 of this example by the above-mentioned linear table, a motor, a gear 30, the gear 31, the shaft 32, the cam 17, and the press member 33.

[0020] And as shown in drawing 10, the 1st clamp 3 and the 2nd clamp 2 are constituted so that the tube to hold may be held in the condition of having crushed aslant. Clamps 3 and 2 have the coverings 3a and 2a attached in base 3b and 2b possible [revolution], and in base 3b and 2b, in order to lay two tubes, they have two slots 3f and 3e established in parallel, and 2f and 2e. And the serrated knife-like lock out members 3h and 2h are formed in the end face of base 3b of the part which Slots 3f and 3e and Slots 2f and 2e face, and 2b. And the lock out members 3g and 2g of the shape of a serrated knife of the configuration corresponding to the lock out members 3h and 2h of the above-mentioned base 3b and 2b are formed in Coverings 3a and 2a. The internal surface of Coverings 3a and 2a is flat. And to Coverings 3a and 2a, it has the revolution cam, respectively, and this revolution cam will engage with the roller of base 3b and 2b, if Coverings 3a and 2a are closed. And when Coverings 3a and 2a are closed, two tubes are aslant crushed by between 3h of lock out members of base 3b, and 3g of lock out members of covering 3a, and between 2h of lock out members of base 2b, and 2g of lock out members of covering 2a, and are held in the condition of having blockaded. Moreover, since the 1st clamp 3 has lobe 3i which projects in the 2nd clamp direction and it has crevice 2i to which the 2nd clamp 2 contains this lobe 3i, the 2nd clamp 2 is constituted so that it cannot blockade, if the 1st clamp 3 is not blockaded.

[0021] And two cams 19 and 17 are being fixed and sterile junction equipment 1 rotates cams 19 and 17 with rotation of a gear 31, as are shown in drawing 1, and it has the gear 30 rotated by the motor, and the gear 31 rotated by rotation of this gear 30 and is shown in the shaft 32 of a gear 31 at drawing 7. And cam-groove 19a for the 1st clamp drive of a configuration as shown in drawing 8 is prepared in the right lateral of a cam 19. And the arm 18 for the 1st clamp migration which has follower 18a which slides on the inside of cam-groove 19a of a cam 19 in the center section is formed. Moreover, the lower limit of an arm 18 is supported by the frame 9 rotatable by supporting-point 18b, and the upper limit of an arm 18 is supported rotatable by supporting-point 18c prepared in clamp standing-ways 3c of the 1st clamp 3. Therefore, along with 3n of rail members of a linear table, as shown in drawing 8, the 1st clamp 3 moves to the rectangular direction back in the level condition to the shaft of two tubes by rotation of a cam 19, as shown in an arrow head according to the configuration of cam-groove 19a.

[0022] The cutting means 5 has wafer attaching part 5a which holds a wafer exchangeable, arm section 5c in

which wafer attaching part 5a was prepared caudad, follower 5b prepared in the edge of arm section 5c, and 5d of hinge regions and attachment section 5e to a frame 9, as shown in drawing 6. And it can circle to a frame 9 by 5d of hinge regions. And as shown in drawing 6, the temperature detection means 7 for temperature detection of the electrical connection terminal 39 for wafer heating and a wafer is being fixed to the right lateral of the cutting means 5. As a temperature detection means 7, it is desirable that they are a thermocouple or a resistance bulb. More preferably, it is a sheath form thermocouple or a resistance bulb, and a sheath form thermocouple is desirable especially. What has the metal plate bent as a wafer 6 so that it might face each other, the insulating layer formed in the inside of this metal plate, the resistor formed so that the above-mentioned metal plate might not be contacted in this insulating layer, and the terminal for energization prepared in the both ends of this resistor is used suitably.

[0023] And the cam 17 has cam-groove 17a for a cutting means drive in the left lateral, as shown in drawing 6 and drawing 9. And follower 5b of the cutting means 5 is located in cam-groove 17a of a cam 17, and slides on the inside of cam-groove 17a in accordance with the configuration of a cam groove. Therefore, by rotation of a cam 17, as shown in drawing 9, the cutting means 5 will move to a rectangular cross and the perpendicular direction upper and lower sides to the shaft of two tubes, if it puts in another way up and down according to the configuration of cam-groove 17a. Furthermore, the cam 17 has cam-groove 17c for the drive of the 2nd clamp 2 in the center section, as shown in drawing 7. Cam-groove 17c has 17f of left laterals, and right lateral 17e, and controls the location of the 2nd clamp by 17f of left laterals, and right lateral 17e. In 2nd clamp standing-ways 2c, it has the lobe extended caudad, and the follower 20 is formed at the tip. This follower 20 slides on the inside of cam-groove 17c for the drive of the 2nd clamp 2. And between the side faces of a follower 20 and cam-groove 17c, as shown in drawing 7, it is formed so that the clearance between some may be made. And since 2nd clamp standing-ways 2c is always pushed by the spring member 33, in a normal state, a follower 20 comes to contact 17f of left laterals of cam-groove 17c, and the clearance between some is made between a follower 20 and right lateral 17e of cam-groove 17c. However, as mentioned above, if two tubes are held by the 1st and 2nd clamps 3 and 2, since it blockades and two clamps 3 and 2 hold, respectively so that two tubes may be crushed, they will arise [the repulsive force resulting from lock out of a tube]. And in the condition that clamps 3 and 2 hold a tube, since the thing of the force smaller than the repulsive force resulting from lock out of the above-mentioned tube is used, as shown in drawing 7, a follower 20 comes to contact right lateral 17e of cam-groove 17c, and the clearance between some is made by the spring member 33 between a follower 20 and 17f of left laterals of cam-groove 17c. However, since the repulsive force to which a tube originates in cutting **** and lock out of a tube with the above-mentioned cutting means 5 disappears, return and a follower 20 come to contact 17f of left laterals of cam-groove 17c, and the clearance between some is made in a normal state between a follower 20 and right lateral 17e of cam-groove 17c. Thus, it is constituted so that the sliding surface of the cam groove which a follower 20 contacts may change with an operation of the spring member 33 and the repulsive force of a tube with time.

[0024] And as shown in drawing 7, 17d of crevices is formed in 17f of left laterals. Since the stage when a follower 20 passes 17d part of this crevice is after cutting of a tube by the cutting means, a follower 20 is in the condition which meets and is sliding on 17f of left laterals of cam-groove 17c, and, therefore, a follower 20 goes into 17d part of crevices. For this reason, the 2nd clamp 2 will move in the 1st clamp 3 direction by the depth of 17d of crevices. Thereby, junction of a tube becomes more certain. And 17g of crevices is established also in right lateral 17e of cam-groove 17c. 17g of this crevice is a thing for cleaning of the inside of clamps 3 and 2. The 2nd clamp 2 can be moved in the direction estranged from the 1st clamp 3, and, thereby, a clearance is formed between the 1st clamp 3 and the 2nd clamp until a follower 20 contacts 17g of crevices by pushing the 2nd clamp 2 on the spring member 33 side by preparing 17g of this crevice. It becomes possible to clean with the cotton swab containing the solvent which can dissolve the formation ingredient of tubes cut to some extent, such as a cleaning member, for example, alcohol etc., into the formed gap. 17g of this crevice is established in the location which faces mostly 17d (part into which ****** of the 2nd clamp 2 is performed) of crevices of 17f of left laterals, as shown in drawing 7. When the follower 20 formed in the lobe to which 2nd clamp standing-ways 2c is extended caudad is contained in 17d part of crevices, it is in the condition which joined both the tubes made into the purpose after tube cutting, and the 2nd clamp stops in this condition. Moreover, the 1st clamp is also already stopped and the 1st clamp 3 is in the location which shifted from the 2nd clamp. As shown in drawing 1, the 1st clamp 3 is retreating from the 2nd clamp 2, and, specifically, the 1st clamp 3 has it in the location which shifted from the 2nd clamp. For this reason, in this condition, the inside of the point of the 2nd clamp 2 is exposed a little, and has also exposed the inside of the back end section of the 1st clamp a little further. Therefore, the cleaning is easy for

the inside of the 2nd clamp 2 and the 1st clamp 3 which were exposed.
[0025] Next, an operation of the sterile junction equipment 1 of this invention is explained using a drawing. Drawing 11 is a timing chart which shows actuation of a cutting means, the 1st clamp, and the 2nd clamp. Drawing 12, drawing 13, and drawing 14 are the flow charts for explaining an operation of sterile junction equipment. Drawing 15, drawing 16, drawing 17, and drawing 18 are the explanatory views for explaining an operation of sterile junction equipment. With this junction equipment 1, the 1st clamp 3 at the time of junction activity termination serves as a location which shifted from the 2nd clamp 2, and is in the halt location of the timing chart of drawing 11. The include angle of the axis of abscissa of the timing chart of drawing 11 makes 0 degree a zero (condition whose location of the 1st clamp and the 2nd clamp suits), and, in other words, are angle of rotation of the shaft 32 of the subsequent gear 31, and a thing which shows the movement toward the cutting means at the time of angle of rotation of a cam 17 and a cam 19 (wafer), the 1st clamp 3, and the 2nd clamp 2.
[0026] First, as first shown in drawing 12 of a flow chart, the electric power switch prepared in the panel 50 of drawing 3 is pushed. By CPU which constitutes by this the controller 40 shown in drawing 3, when it judges whether it is normal (isn't there any omission of an internal connector, or isn't there specifically any open circuit of a thermocouple, or isn't there any defect in the source of an internal constant voltage?) and is abnormal, a buzzer carries out singing of the junction equipment 1. Then, the clamp reset switch 53 prepared in the panel 50 of drawing 3 is pushed. By CPU, it judges whether the 1st and 2nd clamps are open, whether there are any 1st and 2nd clamps in a zero, and whether a wafer exchange lever is in a zero. In addition, since the clamp used with the sterile junction equipment 1 of this example has lobe 3i to which the 1st clamp 3 projects in the 2nd clamp direction as mentioned above and it has crevice 2i to which the 2nd clamp 2 contains this lobe 3i, the 2nd clamp 2 is constituted so that it cannot blockade, if the 1st clamp 3 is not blockaded. For this reason, it is detected by the microswitch 13 with which ON/OFF of the 1st and 2nd clamps being open is carried out by the lever 16 which contacts, and this lever 16 when the 2nd clamp is blockaded. When the 2nd clamp is in a release condition, OFF has come, when the 2nd clamp 2 is blockaded, a lever 16 is contacted, a lever 16 moves, and, specifically, a microswitch 13 makes a microswitch 13 ON condition. The ON/OFF signal of this microswitch 13 is inputted into a controller 40. It is judged that there are no 1st and 2nd clamps in a zero when a microswitch SW5 (73) and SW6 (74) detect the slot prepared on the periphery of each cam. It is detected by the microswitch 14 that the wafer exchange lever 22 is in a zero. When a microswitch 14 serves as ON when a lever 22 is in a zero, and there is nothing at a zero, OFF comes and the ON/OFF signal of this microswitch 14 is inputted into a controller 40.
[0027] And as shown in drawing 12, when all four above-mentioned points are YES(s), a motor is operated and the 1st and 2nd clamps are returned to a zero. Moreover, an abnormality lamp puts out the light by in No, BUSA's carrying out singing, and an abnormality lamp's lighting up, performing manual discharge, and pushing at least one reset switch among four above-mentioned points. After the 1st and 2nd clamps arrive at a zero, the 1st and 2nd clamps are equipped with two flexible tubes 48 and 49. The 1st and 2nd clamps 3 and 2 in this condition are in the condition that 2f faced mutually slot 3e which is in the condition which both opened wide, and was prepared for both, and 2e and 3f, as [show / in drawing 10]. And the slots 3f and 2f of a near side are equipped with the tube 49 in use, and the slots 3e and 2e by the side of the back are equipped with the intact tube 48 connected. And after blockading the 1st and 2nd clamps 3 and 2 as mentioned above, the wafer exchange lever 22 is pushed on a clamp side, and wafers are exchanged. By lengthening the wafer exchange lever 22 to a clamp side, a wafer newer than the inside of the wafer cartridge 8 is taken out, and while push and a standby wafer are equipped with the used wafer with which push and a standby wafer were equipped with the standby wafer with which the cutting means 5 is equipped with a new wafer by the cutting means 5 in an operating location, a used wafer is contained in the used wafer housing 29. By then, CPU which constitutes the controller 40 which will shift to ** of the flow chart of drawing 13 if the initiation switch of a panel 50 is pushed, and is shown in drawing 3 [whether the 1st and 2nd clamps have closed, whether a wafer is exchange settled, and] Whether the 1st and 2nd clamps are in a zero, whether a wafer exchange lever is in a zero, and whether the 1st and 2nd clamps have closed When the 2nd clamp is blockaded, it is detected by the lever 16 which contacts, and the microswitch 13 in which ON/OFF is carried out by this lever 16. When the 2nd clamp is in a release condition, OFF has come, when the 2nd clamp 2 is blockaded, a lever 16 is contacted, a lever 16 moves, and, specifically, a microswitch 13 makes a microswitch 13 ON condition. The ON/OFF signal of this microswitch 13 is inputted into a controller 40. If whether a wafer is exchange settled does push and a wafer exchange activity in the clamp direction for the wafer exchange lever 22, since the exchange lever 22 makes a microswitch 15 turn on once, it will be detected whether it was exchanged by ON signal from a microswitch 15. The

ON/OFF signal of a microswitch 15 is inputted into a controller 40. Whether the 1st and 2nd clamps are in a zero detects with a microswitch 13 as mentioned above.

[0028] And as shown in drawing 13, in No, BUSA carries out singing and returns to ** of drawing 12 at least one of the four above-mentioned points. Moreover, when all the four above-mentioned points are YES (s), the working lamp 47 lights up and heating of a wafer is started. It is for or or judging [whose a wafer current is beyond the set point] whether a judgment was made and the wafer has short-circuited this after heating initiation of a wafer. And when a wafer current is not beyond the set point (the electrical potential difference concerning shunt resistance beyond a predetermined value), after waiting for 0.3 seconds, it judges whether a wafer current is set point within the limits. When a wafer is a used thing, since resistance falls for the heat history of a resistor, this measures a wafer current, detects whether it is in a setting range (inside of tolerance) as compared with the wafer current set up beforehand, and, thereby, judges electrically whether a wafer is used. After BUSA carries out singing, suspending heating of a wafer, and the abnormality lamp in a wafer lighting up and pushing a reset switch when the above-mentioned wafer current is beyond the set point, and when an above-mentioned wafer current is not in a setting range (when the wafer has short-circuited) (when a wafer is used), it shifts to flow chart ** of drawing 12. And heating of a wafer is continued when it is in a setting range (inside of tolerance) as compared with a wafer current. Heating of a wafer 6 is performed controlling the source 43 of a constant voltage by the Pulse-Density-Modulation signal computed based on the temperature detection output of the thermocouple 7 which is a wafer temperature detection means. and in order to prevent superfluous heating of a wafer, when it judges whether the heating time of a wafer is predetermined within a time, and it judges whether a wafer current is predetermined value within the limits and beyond the predetermined value, i.e., a wafer, has caused short circuit accident, immediately, BUSA carries out singing, suspends heating of a wafer, and shifts to flow chart ** of drawing 12. And if the temperature of a wafer reaches laying temperature, it shifts to flow chart ** of drawing 14, and a motor operates, thereby, a gear 30, a gear 31, and cams 19 and 17 will rotate, a cutting means (wafer) will go up, and ****** by the side of cutting of a tube, retreat of the 1st clamp, descent of a cutting means (wafer), and the 1st clamp of the 2nd clamp will be performed.

[0029] If it explains concretely, follower 5b of the cutting means 5 will slide on the inside of cam-groove 17a first by rotating in the direction of an arrow head which a cam 17 shows to drawing 9. From the condition that the zero O of a cam groove shown in drawing 9 and drawing 11 at the beginning touched follower 5b, the point A of cam-groove 17a shown in drawing 9 and drawing 11 comes to contact follower 5b. And as shown in drawing 11, gently-sloping, the cutting means 5 goes up and two flexible tubes are cut from the condition that the point A of cam-groove 17a shown in drawing 9 and drawing 11 contacts follower 5b in the meantime, until the point B of cam-groove 17a results in the condition of contacting follower 5b. If it explains using drawing 15 and drawing 16, two tubes 48 and 49 are held by the 1st clamp 3 and the 2nd clamp 2, the tube parts 48a and 49a located between the 1st clamp 3 and the 2nd clamp 2 are formed, and the wafer 6 of a cutting means is located in the lower part. And as mentioned above, by rotation of a cam 17, when the cutting means 5 (wafer 6) goes up, as shown in drawing 16, melting cutting of both is carried out in the tube parts 48a and 49a located between the 1st clamp 3 of two tubes, and the 2nd clamp 2.

[0030] And as shown in drawing 9 and drawing 11, the condition that the cutting means 5 went up is maintained, and the edge from which Tubes 48a and 49a were cut is fully dissolved, until it results in the condition that the point C of cam-groove 17a contacts follower 5b from the condition that the point B of cam-groove 17a shown in drawing 9 contacts follower 5b. And as shown in drawing 9 and drawing 11, the cutting means 5 descends gently-sloping, until the point E of cam-groove 17a results [from the condition that the point C of cam-groove 17a shown in drawing 9 and drawing 11 contacts follower 5b] in the condition of contacting follower 5b. Moreover, as shown in drawing 8, when a cam 19 rotates in the direction of an arrow head, follower 18a prepared in the arm 18 for moving the 1st clamp slides on the inside of cam-groove 19a. From the condition that the zero O of a cam groove shown in drawing 8 and drawing 11 at the beginning touched follower 18a, the point F of cam-groove 19a shown in drawing 8 and drawing 11 comes to contact follower 18a. As shown in the timing chart of drawing 11, follower 18a results in cam-groove 19 a point F early a little rather than follower 5b of the cutting means 5 results in the point B of cam-groove 17a. And as shown in drawing 11, gradually, the 1st clamp 3 retreats, will be in the condition which shows in drawing 17, and will be in the condition that the tube parts 49a and 48a joined faced each other through the wafer 6, until the point G of cam-groove 19a results [from the condition that the point F of cam-groove 19a contacts follower 18a] in the condition of contacting follower 18a, as shown in drawing 8 and drawing 11. As shown in the timing chart of drawing 11, this condition is maintained from the condition that the point G of cam-groove 19a contacts follower 18a until the point C of cam-groove 17a

results in the condition of contacting follower 5b. And the condition of drawing 17 is maintained until the location of the 1st clamp results [from the condition that Point G contacts follower 18a] in the condition that the point H of cam-groove 19a contacts follower 18a. In addition, as the cutting means 5 is shown in drawing 9 and drawing 11 until the point E of cam-groove 17a results [from the condition that the point C of cam-groove 17a shown in drawing 9 and drawing 11 contacts follower 5b as mentioned above] in the condition of contacting follower 5b, it descends gently-sloping and the tube parts 48a and 49a joined contact.

[0031] And with the time of resulting in the condition which descent of the cutting means 5 ended, and the condition that the point E of cam-groove 17a contacts follower 5b, mostly, as shown in drawing 7 and drawing 11, in other words, the 2nd clamp 2 performs ****** to coincidence at the 1st clamp side. As shown in drawing 7 and drawing 11, specifically the point M of 17d of crevices of 17f of left laterals of cam-groove 17c Gradually until the point L of a left lateral results [from the condition of contacting the follower 20 for making the 2nd clamp 2 driving] in the condition of contacting a follower 20 the 2nd clamp 2 It moves to the 1st clamp 3 side, and the condition of having ******(ed) is maintained until the point K of 17d of crevices results [from the condition that the point L of 17d of crevices of cam-groove 17c contacts a follower 20] in the condition of contacting a follower 20. By this ******, since both of the tube parts 48a and 49a stick certainly, they can make both junction a more positive thing. And gradually, the 2nd clamp 2 moves in the direction separated from the 1st clamp 3 side, and actuation of a motor stops it in this condition until the point J of 17f of left laterals results [from the condition that the point K of 17d of crevices of cam-groove 17c contacts a follower 20] in the condition of contacting a follower 20.

[0032] Therefore, the location of the 1st clamp 3 and the 2nd clamp 2 in the stopped location is the location shifted like drawing 17, as shown in drawing 18. And if wafer temperature is detected by the thermocouple and wafer temperature becomes below the set point as shown in the flow chart of drawing 14, a run light will put out the light and BUSA will carry out singing. And as shown in drawing 18, the junction activity of a tube is completed by opening the 1st clamp 3 and the 2nd clamp 2, and taking out a tube. Moreover, if it puts in another way until the point C of cam-groove 17a results in the condition of contacting follower 5b, from the condition that the point A of cam-groove 17a shown in drawing 7 and drawing 11 contacts follower 5b, although not indicated to the flow chart of drawing 14 It judges whether as shown in the flow chart of drawing 13, a wafer is laying temperature after the cutting means 5 starts a rise also until it starts descent. It is desirable to control the source 43 of a constant voltage by the Pulse-Density-Modulation signal computed based on the temperature detection output of the thermocouple 7 which is a wafer temperature detection means, and to perform temperature control of a wafer. Since the heat of a wafer is absorbed with a tube and this falls when a wafer contacts the tubes 48 and 49 to cut even if a wafer reaches laying temperature once, it is for performing the amendment. The heating control circuit 55 in drawing 4 especially the temperature detection signal a from the thermocouple which is the temperature detection means 7 as mentioned above The PID amendment machine 56 (proportionality and differential / integral amendment machine 1) of the amendment wafer temperature calculation section 51 amends. The amended amendment temperature signal b shall be outputted and it is the amendment Formula 1b=1-/K-a- (1+K1 and T-da/dt) ... By (1), if correction value shall be computed Since the amendment temperature signal b has amended the time lag until the actual temperature of the thermocouple which is a temperature detection signal falls by the fall of the temperature of a wafer in K1 and T-da/dt Since the fall temperature of an actual wafer is detected correctly, temperature control of a wafer can be performed early [correspondence].

[0033]

[Effect of the Invention] The flexible tube sterile junction equipment of this invention is equipment for joining a flexible tube in sterile. This equipment It has a cutting means for cutting said flexible tube between the 1st clamp and the 2nd clamp holding a tube, and this 1st clamp and the 2nd clamp. Said cutting means The source of a constant voltage for heating the wafer and this wafer for carrying out melting cutting of the flexible tube, Having a wafer temperature detection means and a wafer heating control means, said wafer heating control means has the Pulse-Density-Modulation signal output part computed based on the output of said wafer temperature detection means, and controls said source of a constant voltage by this Pulse-Density-Modulation signal. By using the source of a constant voltage, and a Pulse-Density-Modulation signal circuit especially, power consumption can be made small, further, by controlling the source of a constant voltage by the Pulse-Density-Modulation signal, temperature control of a wafer for heating melting to cut a flexible tube can be performed certainly, and a positive tube can be joined.

[Brief Description of the Drawings]

[Drawing 1] Drawing 1 is the perspective view of one example of the flexible tube sterile junction

equipment of this invention.
[Drawing 2] Drawing 2 is the perspective view showing the condition of having contained in the case the sterile junction equipment shown in drawing 1.
[Drawing 3] Drawing 3 is the block diagram showing an example of the electrical circuit used for the sterile junction equipment of this invention, and is **.
[Drawing 4] Drawing 4 is the electrical circuit block diagram showing an example of the wafer heating control means of the electrical circuit of the sterile junction equipment of this invention.
[Drawing 5] Drawing 5 is the plan of one example of the flexible tube sterile junction equipment of this invention.
[Drawing 6] Drawing 6 is the explanatory view of the cutting means used for the flexible tube sterile junction equipment of this invention.
[Drawing 7] Drawing 7 is an explanatory view in order to explain actuation of the 1st clamp, the 2nd clamp, and a cutting means.
[Drawing 8] Drawing 8 is an explanatory view for explaining actuation of the 1st clamp.
[Drawing 9] Drawing 9 is an explanatory view for explaining actuation of a cutting means.
[Drawing 10] Drawing 10 is the perspective view showing an example of the 1st and 2nd clamps used for the sterile junction equipment of this invention.
[Drawing 11] Drawing 11 is a timing chart which shows the timing of the 1st clamp, the 2nd clamp, and a cutting means of operation.
[Drawing 12] Drawing 12 is a flow chart for explaining an operation of the sterile junction equipment of this invention.
[Drawing 13] Drawing 13 is a flow chart for explaining an operation of the sterile junction equipment of this invention.
[Drawing 14] Drawing 14 is a flow chart for explaining an operation of the sterile junction equipment of this invention.
[Drawing 15] Drawing 15 is an explanatory view for explaining an operation of the sterile junction equipment of this invention.
[Drawing 16] Drawing 16 is an explanatory view for explaining an operation of the sterile junction equipment of this invention.
[Drawing 17] Drawing 17 is an explanatory view for explaining an operation of the sterile junction equipment of this invention.
[Drawing 18] Drawing 18 is an explanatory view for explaining an operation of the sterile junction equipment of this invention.
[Drawing 19] Drawing 19 is the schematic diagram of the circuit of the heating means which used the constant current source.
[Drawing 20] Drawing 20 is the schematic diagram of the circuit of the heating means which used the source of a constant voltage.
[Description of Notations]
1 Sterile Junction Equipment
2 2nd Clamp
3 1st Clamp
5 Cutting Means
6 Wafer
7 Wafer Temperature Detection Means
13 Microswitch 1
14 Microswitch 2
15 Microswitch 3
40 Controller
41 Rectification Power Circuit
42 Motor
43 Source of Constant Voltage
44 Wafer Heating Control Means
50 Input Panel
59 Pulse-Density-Modulation Signal Output Part
65 Wafer Short Circuit Protection Network
[Procedure amendment 2]

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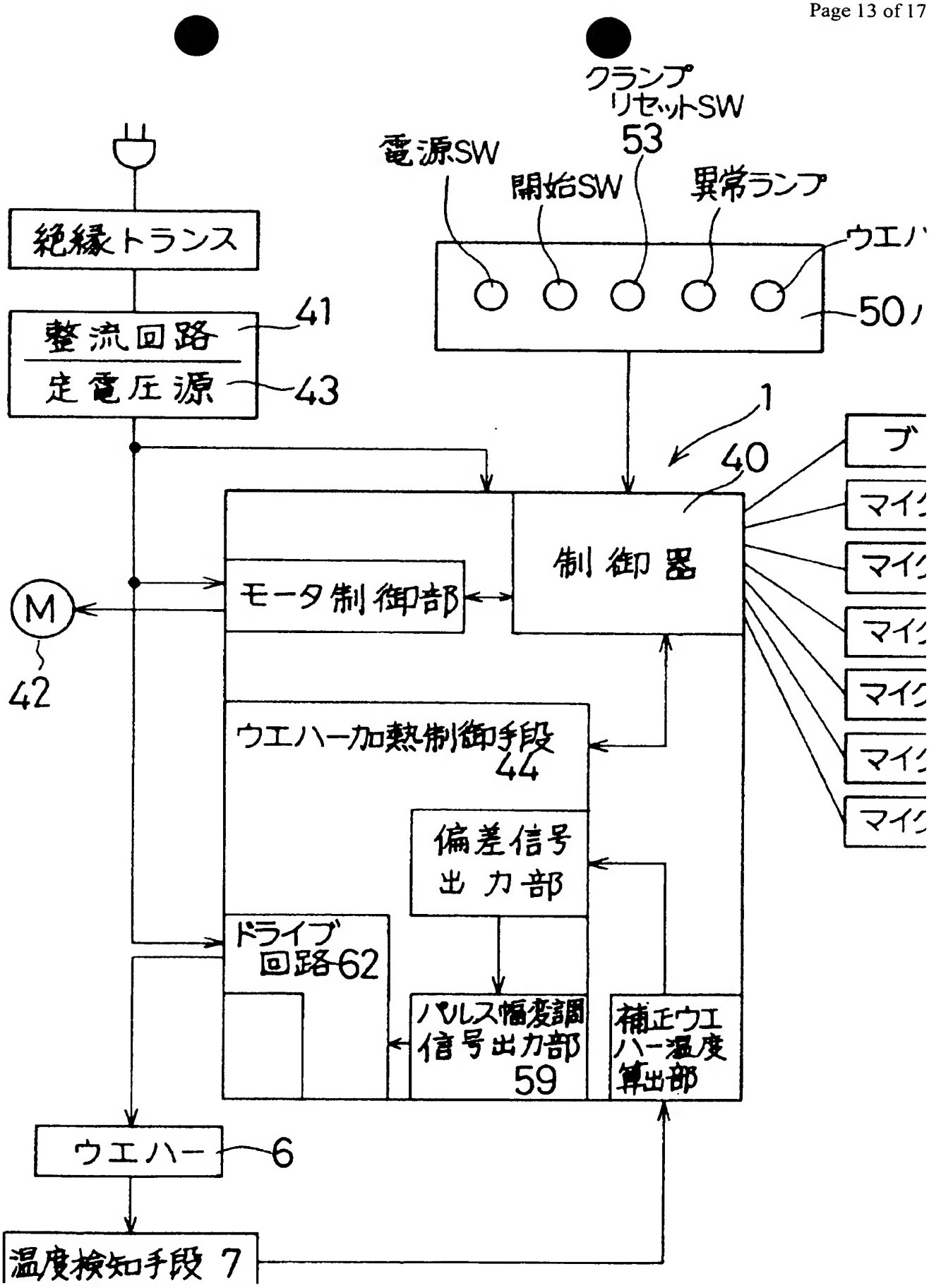
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 3]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温度検知手段 7

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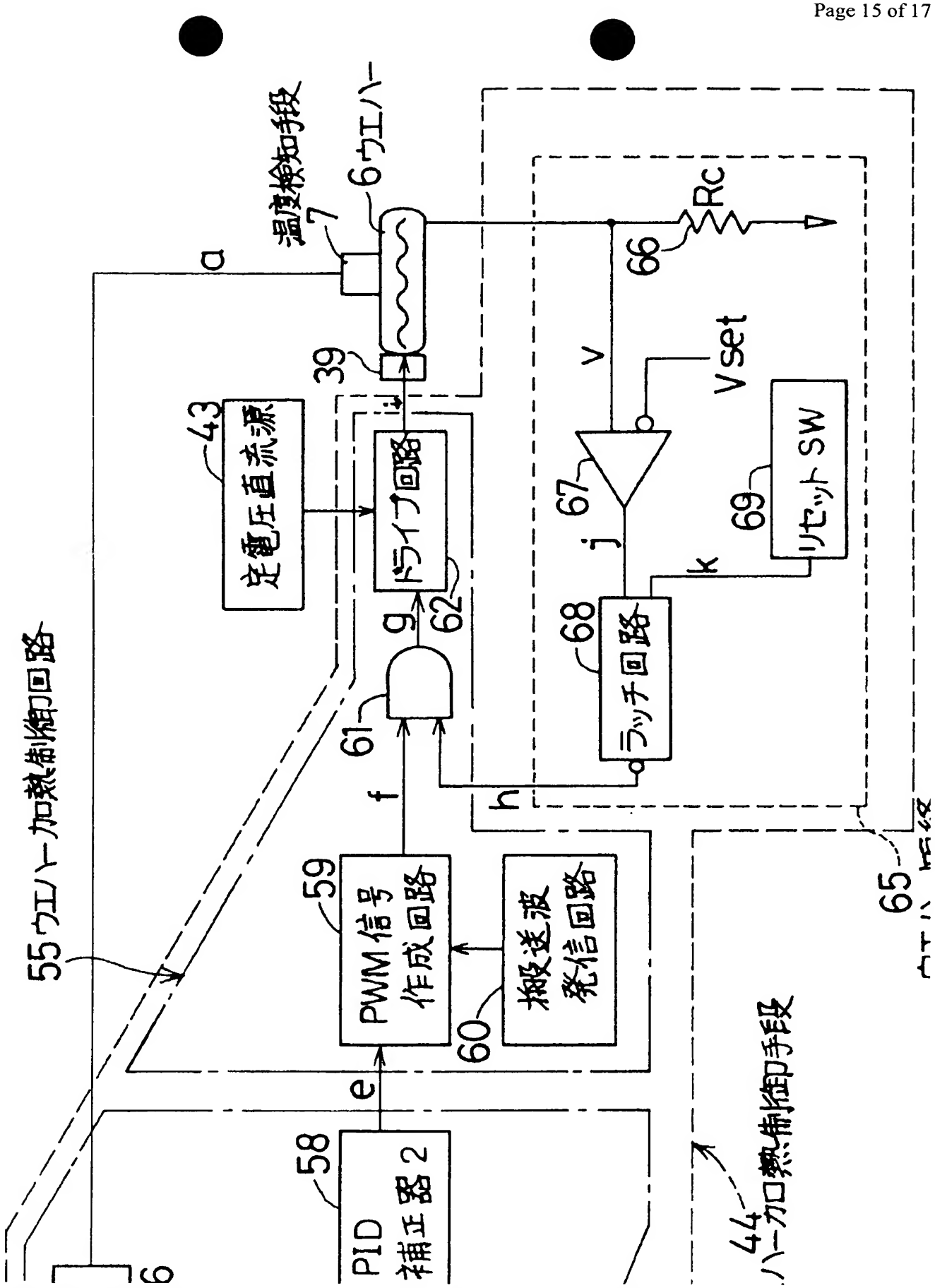
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 4]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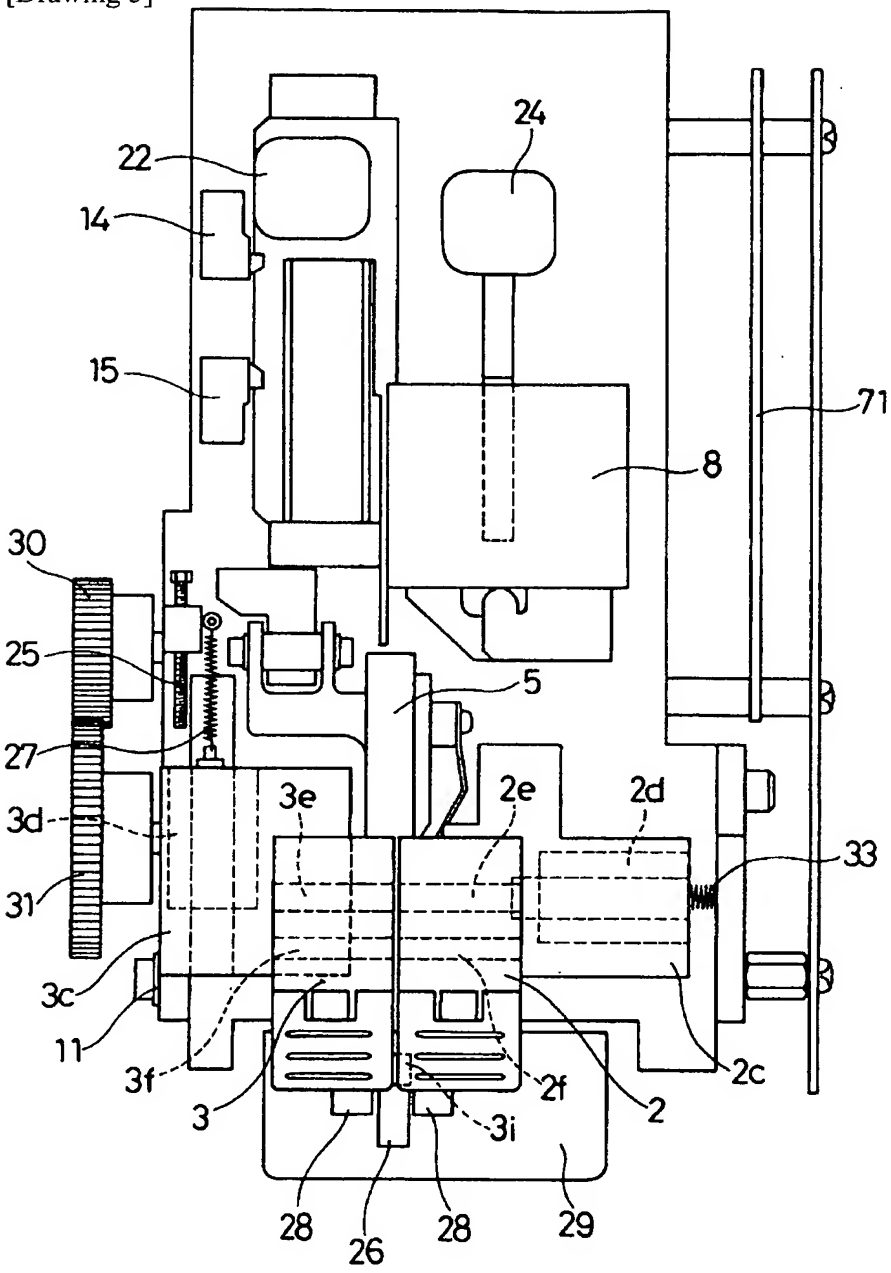
[Drawing 5]



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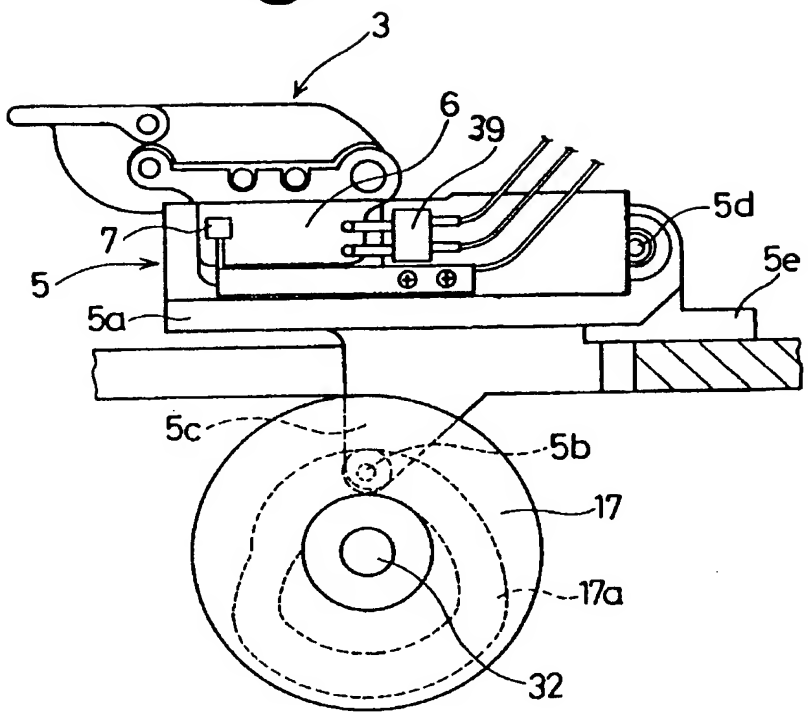
[Drawing 6]



[Translation done.]

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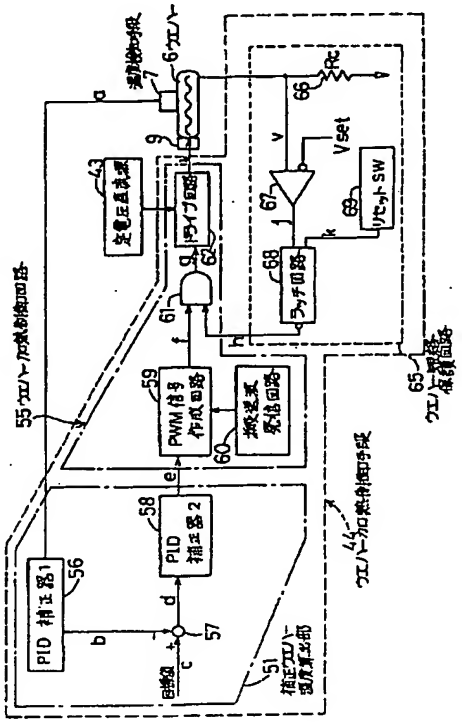
(54)【発明の名称】可撓性チューブ無菌的接合装置

(57)【要約】

【目的】　可撓性チューブを加熱溶融により切断するためのウエハーの温度制御を確実に行うことができ、さらに、消費電力が少ない可撓性チューブ無菌的接合装置を提供する。

【構成】　少なくとも２本の可撓性チューブを平行状態にて保持する２つのクランプと、２つのクランプ間にてチューブを切断するための切断手段と、切断されたチューブの接合される端部相互が密着するようにいずれかのクランプを移動させる移動手段とを有している。切断手段は、チューブ溶融切断用ウエハーと、ウエハー加熱用定電圧源と、ウエハー温度検知手段と、ウエハー加熱制御手段とを有し、ウエハー加熱制御手段は、温度検知手段の出力に基づいて、算出されるパルス幅変調信号出力部を有し、パルス幅変調信号により定電圧源を制御するものである。



【特許請求の範囲】

【請求項１】　可撓性チューブを無菌的に接合するための装置であって、該装置は、少なくとも２本の可撓性チューブを平行状態にて保持する第１クランプおよび第２クランプと、該第１クランプおよび第２クランプ間にて前記可撓性チューブを切断するための切断手段と、該切断手段により切断された可撓性チューブの接合される端部相互が密着するように前記第１クランプまたは前記第２クランプの少なくとも一方を移動させる移動手段とを有し、前記切断手段は、前記可撓性チューブを溶融切断するためのウエハーと、該ウエハーを加熱するための定電圧源と、ウエハー温度検知手段と、ウエハー加熱制御手段とを有し、前記ウエハー加熱制御手段は、前記ウエハー温度検知手段の出力に基づいて、算出されるパルス幅変調信号出力部を有し、該パルス幅変調信号により前記定電圧源を制御するものであることを特徴とする可撓性チューブ無菌的接合装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、少なくとも２本の可撓性チューブを加熱溶融して、無菌的に接続するための可撓性チューブ無菌的接合装置に関する。

【０００２】

【従来の技術】輸血システムにおける採血バッグおよび血液成分バッグのチューブ接続、持続的腹膜透析（ＣＡＰＤ）における透析液バッグと廃液バッグの交換時などには、チューブの接続を無菌的に行うことが必要となる。このようなチューブの無菌的接続を行う装置としては、特公昭６１－３０５８２号公報に示されものがある。この特公昭６１－３０５８２号公報に示されている装置は、チューブを加熱溶融して接続するチューブ接続装置であり、接続すべき２本の可撓性チューブを平行状態にて保持する第１クランプおよび第２クランプと、第１クランプおよび第２クランプ間にて可撓性チューブを切断するための切断手段と、切断手段により切断された可撓性チューブの接合される端部相互が密着するように第１クランプまたは第２クランプの少なくとも一方を移動させる移動手段とを有している。

【０００３】そして、切断手段は、可撓性チューブを溶融切断するためのウエハーと、ウエハーを加熱するための電源とを有している。ウエハーを加熱するための電源としては、特開昭５９－６４０３４号公報に示されているように、定電流源を用いている。そして、ウエハーの温度制御は、抵抗体の抵抗値温度変化を利用して、抵抗値よりウエハーの温度を予測する方法を用いている。

【０００４】

【発明が解決しようとする課題】しかし、特開昭５９－６４０３４号公報に示されているように、定電流源を用い、ウエハーの温度制御は、抵抗体の抵抗値温度変化を利用して、抵抗値よりウエハーの温度を予測する方法では、実際にウエハーの温度を測定し制御するものではないので、確実な温度制御を行うことが困難であるという問題点を有している。さらに、定電流源を用いた加熱回路では、駆動回路の損失が大きいため、消費電力が大きいよいう問題点もあった。　そこで、本発明の目的は、可撓性チューブを加熱溶融により切断するためのウエハーの温度制御を確実に行うことができ、さらに、消費電力が少ない可撓性チューブ無菌的接合装置を提供するものである。

【０００５】

【課題を解決するための手段】上記目的を達成するものは、可撓性チューブを無菌的に接合するための装置であって、該装置は、少なくとも２本の可撓性チューブを平行状態にて保持する第１クランプおよび第２クランプと、該第１クランプおよび第２クランプ間にて前記可撓性チューブを切断するための切断手段と、該切断手段により切断された可撓性チューブの接合される端部相互が密着するように前記第１クランプまたは前記第２クランプの少なくとも一方を移動させる移動手段とを有し、前記切断手段は、前記可撓性チューブを溶融切断するためのウエハーと、該ウエハーを加熱するための定電圧源と、ウエハー温度検知手段と、ウエハー加熱制御手段とを有し、前記ウエハー加熱制御手段は、前記ウエハー温度検知手段の出力に基づいて、算出されるパルス幅変調信号出力部を有し、該パルス幅変調信号により前記定電圧源を制御するものである可撓性チューブ無菌的接合装置である。

【０００６】そして、前記ウエハー加熱制御手段は、前記ウエハー温度検知手段の出力に基づいて、補正ウエハー温度算出部と、該算出部により算出された補正温度と前記ウエハーの目的加熱温度との偏差信号を出力する偏差信号出力部とを有し、前記パルス幅変調信号出力部は、該偏差信号に基づいてパルス幅変調信号を出力するものであることが好ましい。さらに、前記ウエハー加熱制御手段は、ウエハー短絡保護回路を有していることが好ましい。また、前記ウエハー加熱制御手段は、該パルス幅変調信号により前記定電圧源を制御するためのドライブ回路を有しており、前記ウエハー短絡保護回路は、前記ウエハーの短絡検知部と、該短絡検知部の検知信号に基づき、前記パルス幅変調信号出力部からのパルス幅変調信号の前記ドライブ回路への流入を制御するパルス幅変調信号制御部を有していることが好ましい。また、前記補正ウエハー温度算出部は、比例・積分・微分補正回路を有していることが好ましい。さらに、前記偏差信号出力部は、比例・積分・微分補正回路を有していることが好ましい。そして、前記ウエハー温度検知手段は、熱電対または測温抵抗体であることが好ましい。さらに、前記ウエハー温度検知手段は、シース形熱電対または測温抵抗体であることが好ましい。

【０００７】そこで、本発明の可撓性チューブ無菌的接

合装置について、図面を参照して説明する。この可撓性チューブ無菌的接合装置１は、可撓性チューブを無菌的に接合するための装置であって、少なくとも２本の可撓性チューブを平行状態にて保持する第１クランプ３および第２クランプ２と、第１クランプ３および第２クランプ２間にて可撓性チューブ４８，４９を切断するための切断手段５と、切断手段５により切断された可撓性チューブ４８，４９の接合される端部相互４８ａ，４９ａが密着するように第１クランプ３または第２クランプ２の少なくとも一方を移動させる移動手段とを有し、切断手段５は、可撓性チューブ４８，４９を溶融切断するためのウエハー６と、ウエハー６を加熱するための定電圧源４３と、ウエハー温度検知手段７と、ウエハー加熱制御手段４４とを有し、ウエハー加熱制御手段４４は、ウエハー温度検知手段７の出力に基づいて、算出されるパルス幅変調信号出力部５９を有し、パルス幅変調信号により定電圧源４３を制御するものである。

【０００８】図１は、本発明の可撓性チューブ無菌的接合装置の一実施例の斜視図であり、図２は、図１に示した無菌的接合装置をケースに収納した状態を示す斜視図であり、図３は、本発明の無菌的接合装置に使用される電気回路の一例を示すブロック図であり、図４は、本発明の無菌的接合装置の電気回路のウエハー加熱制御手段の一例を示す電気回路ブロック図である。図５は、本発明の可撓性チューブ無菌的接合装置の一実施例の上面図である。

【０００９】次に、図４に記載するウエハー加熱制御手段について説明する。ウエハー６としては、向かい合うように折り曲げられた金属板と、この金属板の内面に形成された絶縁層と、この絶縁層内に上記の金属板と接触しないように形成された抵抗体と、この抵抗体の両端部に設けられた通電用端子とを有するものが好適に使用される。そして、抵抗体は、通電により発熱するため、抵抗体の発熱は、金属板に伝導されウエハー全体が通電により発熱する。そして、抵抗体は、通電による発熱により、抵抗値が変化する。よって、定電圧源を単に使用し、ウエハーへの電力供給を調整するだけでは、十分なウエハーの温度制御ができない。そこで、この実施例の無菌的接合装置１では、ウエハー加熱制御手段を有している。

【００１０】ウエハー加熱制御手段４４は、図４に示すように、ウエハー加熱制御回路５５および補正ウエハー温度算出回路５１を有しており、さらに、図４に示すようにウエハー短絡保護回路６５を有することが好ましい。ウエハー加熱制御回路５５は、温度検知手段７からのの出力に基づいて、算出されるパルス幅変調信号出力部５９を有し、パルス幅変調信号により定電圧源４３を制御するものである。具体的には、ウエハー温度検知手段７の出力に基づいて、補正ウエハー温度を算出する補正ウエハー温度算出部５６と、算出部により算出された補正温度とウエハーの目的加熱温度との偏差信号を出力する偏差信号出力部５７とを有し、パルス幅変調信号出力部５９は、偏差信号に基づいてパルス幅変調信号を出力するものである。温度検知手段７としては、熱電対または測温抵抗体であることが好ましい。より好ましくは、シース形熱電対または測温抵抗体であり、特に、シース形熱電対が好ましい。

【００１１】図４を用いて、加熱制御手段４４をより具体的に説明すると、温度検知手段７である熱電対からの温度検知信号ａが、補正ウエハー温度算出部５６であるＰＩＤ補正器１（比例・微分・積分補正器１）に入力され、補正された補正温度信号ｂが出力される。このＰＩＤ補正器５６では、例えば、式１

$$b = 1/K \cdot a \cdot (1 + K1 \cdot T \cdot da/dt) \cdots (1)$$

により、補正値を算出する。Ｋは、ウエハーと熱電対との結合係数であり、Ｋ１は、切断される可撓性チューブに起因する補正係数であり、Ｔは、熱電対の熱時定数である。このような補正を行う目的は、ウエハーと熱電対との間での熱伝導損失に基づく補正（Ｋ）を行うこと、熱電対の熱時定数（Ｔ）を考慮した補正を行うことにある。そして、式１に示すように、補正温度信号ｂは、１／Ｋは定数であるので、実測されたウエハー温度信号ａより、ウエハー温度が上昇している間は、Ｋ１・Ｔ・ｄａ／ｄｔ分だけ、高く算出される。熱電対が検知する温度は、熱電対の内部温度であり、ウエハーの表面温度に対して遅れを持っている。しかし、上記の補正を行うことにより、熱電対の遅れを一次遅れに近似して時定数Ｔとし、補正関数としては、逆に時定数Ｔの二次進み演算を行うので、ウエハー表面温度を時間遅れなく正確に算出することができる。

【００１２】また、式１に示すような補正を行うことにより、ウエハー温度下降時にも、正確なウエハー表面温度を時間遅れなく正確に算出することができる。そして、サンプリングタイム（△ｔ）を考慮して、式１を書き直すと、式２となる。

$$b(t+\Delta t) = 1/K \cdot a(t+\Delta t) \cdot \{1 + K1 \cdot T/\Delta t \cdot [a(t+\Delta t) - a(t)]\} \cdots (2)$$

このようにして、算出される補正温度信号ｂは、目標とするウエハー温度信号ｃと比較され、偏差信号出力部５７より偏差信号ｄが出力される。この偏差信号ｄは、制御系の応答性を高めるために適当な伝達関数に設計されたＰＩＤ補正器２に入力され、補正偏差信号ｅとして、出力される。この補正偏差信号ｅは、ＰＷＭ（パルス幅変調）信号作成回路５９に入力される。ＰＷＭ信号作成回路５９は、上記の補正偏差信号ｅと搬送波発振回路６

０によって作成される所定周波数に同期し、補正偏差信号ｅに比例したパルス幅の信号（ＰＷＭ変調したパルス列信号）ｆを出力する。このパルス列信号ｆは、ゲート回路６１を通り、ドライブ回路６２に流入する。ドライブ回路６２は、半導体スイッチング素子であるトランジスタ、サイリスタなどにより構成されており、入力されたパルス列信号ｇは、スイッチング、タイミング信号として作用し、パルス列信号ｇがＨの状態のときのみ、定電圧源とウエハーが接続される。ドライブ回路６２とウエハー６との接続は、接続端子９により行われてる。定電圧源４３とウエハー６は、パルス列信号ｇに基づき断続的に接続され、ウエハーは、目的とするウエハー温度に制御される。

【００１３】そして、定電流方式の場合の加熱回路の概略は、図１９に示すようになり、定電流方式の加熱回路の損失を求めると、損失（Ｗｏ）は、

Ｗｏ’＝（Ｖｉ－Ｖｏ）Ｉｏであり、

Ｗｏ’＝[Ｖｃｅ＋｛（Ｖｉ－Ｖｃｅ）－Ｖｏ｝]・Ｉｏ　（Ａ）となる。また、ＰＷＭ方式の場合の加熱回路の概略は、図２０に示すようになり、駆動回路の損失（Ｗｏ）は、

Ｗｏ＝Ｖｏ／Ｖｉ・Ｖｃｅ・Ｉｏ＋Ｗ１であり、（Ｂ）Ｗ１は、ドライブ回路を構成するトランジスタのスイッチング損失である。そして、ＷｏとＷｏ’を比較すると、Ｂ式において、一般的に次の関係が成り立つ。

Ｖｏ／Ｖｉ・Ｖｃｅ・Ｉｏ＞Ｗ１

次に、Ａ式において、一般的に次の関係が成り立つ。

Ｖｃｅ≪（Ｖｉ－Ｖｃｅ）－Ｖｏ

これにより、Ａ式およびＢ式の第１項目、第２項目を比較すると、

Ｖｏ／Ｖｉ・Ｖｃｅ・Ｉｏ＜Ｖｃｅ・Ｉｏ

Ｗ１＜（Ｖｉ－Ｖｃｅ）－Ｖｏ｝・Ｉｏ

よって、Ｗｏ＜Ｗｏ’となり、ＰＷＭ方式の方が、定電流方式に比べて、消費電力が小さいものである。

【００１４】次に、ウエハー短絡保護回路について、図４を用いて説明する。通常状態においては、コンパレータ６７からの信号ｊが、ラッチ回路６８に入力されていないため、ラッチ回路６８は、ゲート回路６１（アンド回路）に対して、常にＨの信号を出力している。このため、ゲート回路は、ＰＷＭ信号ｆのＯＮ／ＯＦＦ（Ｈ／Ｌ）に従って、信号ｇをドライブ回路６２に出力する。そして、図４に示すように、ウエハー６には、シャント抵抗６６が、電気的に接続されており、シャント抵抗６６の電圧Ｖは、コンパレータ６７により、設定電圧Ｖｓｅｔと比較されている。通常状態では、シャント抵抗間の電圧Ｖは、設定電圧Ｖｓｅｔより低いため、コンパレータ６７から信号ｊは出力されない。しかし、ウエハー６が短絡すると、シャント抵抗６６に規定以上の電流が流れるため、シャント抵抗６６の電圧Ｖが上昇し、設定電圧Ｖｓｅｔより大きくなると、コンパレータ６７から信号ｊが、ラッチ回路６８に出力される。ラッチ回路６８は、一度信号ｊが入力されるとその状態を保持する機能を有している。このため、一度信号ｊが入力されると、ゲート回路６１（アンド回路）に対して、常にＬの信号を出力する。このため、ゲート回路６１からは、ＰＷＭ信号ｆに基づく信号ｇが、ドライブ回路６２に出力されなくなり、回路が保護される。そして、短絡事故を起こしたウエハーを交換した後、リセットスイッチ６９を押すと、ラッチ回路６８は、ゲート回路６１（アンド回路）に対して、Ｈの信号を出力する。ラッチ回路６８は、一度リセット信号ｋが入力されるとその状態を保持し、通常状態に復帰する。

【００１５】次に、無菌的接合装置１の全体の機構について説明する。この無菌的接合装置１は、図１、図２、図５、図１０に示すように、少なくとも２本の可撓性チューブを平行状態にて保持する第１クランプ３および第２クランプ２を有している。モータの作動により回転するギア３０、ギア３０の回転により回転するギア３１、ギア３１の回転により回転するシャフト３２、シャフトの両端が回転可能に固定されたフレーム９、第１クランプ３の原点位置でのがたつきを防止するための防止部材１１、マイクロスイッチ１３，１４，１５、第１クランプ３を移動させるための駆動用アーム１８、第１クランプ３を移動させるためのカム１９、切断手段５、切断手段５および第２クランプを駆動させるためのカム１７、第２クランプ２を第１クランプ側に押圧する押圧部材３３、第１クランプ３の後退位置を規制する規制部材２５、第１クランプ３のがたつきを防止するためのバネ部材２７、ウエハー交換レバー２２，ウエハーカートリッジ８、ウエハーカートリッジ交換レバー２４、使用済ウエハー収納箱把持部材２８、使用済ウエハーを収納箱に誘導するための誘導部材２６、使用済ウエハー収納箱２９、操作パネル５０を有している。

【００１６】そして、この無菌的接合装置１は、切断手段５により切断された可撓性チューブ４８，４９の接合される端部相互４８ａ，４９ａが向かい合うように第１クランプ３を移動させる第１クランプ移動機構と、切断手段５をチューブ側に（上方に）移動させ、切断後再びチューブより離れる方向（下方に）に移動させるための移動機能と、第２クランプ２を第１クランプ３に対して、近接および離間する方向に移動させる第２クランプ移動機構とを有している。切断手段駆動機構には、切断手段５を２本のチューブの軸に対して垂直に上方に移動させ、チューブ切断後下方に移動させるものであり、第１クランプ移動機構は、チューブ切断後、第１クランプ３を２本のチューブの軸に対して水平状態にて直交方向（より具体的には、後方に）に移動させるものであり、第２クランプ移動機構は、第２クランプ２を第１クランプ側に近づくように、２本のチューブの軸に対して水平状態にてごくわずか平行に移動させるものである。

【００１７】そこで、第１および第２クランプ３，２について説明する。第１および第２クランプ３，２は、図１、図５、図７および図１０に示すように構成されている。具体的には、第１クランプ３は、図１０に示すように、ベース３ｂと、このベース３ｂに回転可能に取り付けられたカバー３ａと、ベース３ｂが固定されたクランプ固定台３ｃを有している。そして、このクランプ固定台３ｃは、リニアテーブルに固定されている。リニアテーブルは、クランプ固定台３ｃの下面に固定された移動台３ｃと、移動台３ｃの下部に設けられたレール部材３ｎにより構成されている。そして、このリニアテーブルにより、第１クランプ３は、接合するチューブ４８，４９の軸に対して垂直方向、言い換えれば、切断された可撓性チューブの接合される端部相互が向かい合うよう、歪みがなく移動する。よって、この実施例の無菌的接合装置１では、第１クランプ移動機構は、上記のリニアテーブル、モータ、ギア３０、ギア３１、シャフト３２、駆動用アーム１８、カム１９により構成されている。そして、この接合装置１では、図１および図５に示すように、第１クランプ固定台３ｃの後方と、接合装置１のフレームとを接続するバネ部材２７が設けられており、第１クランプ３は、常時後方に引っ張られた状態となっており、第１クランプ３（正確には、第１クランプ固定台３ｃ）のがたつきを少ないものとしている。また、図１、図５に示すように、第１クランプ３のチューブ装着位置（言い換えれば、第１クランプが最も前に出た状態の位置）にて、第１クランプ２のがたつきを防止するための防止部材１１が、フレーム９の側面に固定されている。よって、第１クランプ３は、チューブ装着位置では、バネ部材２７により後方に引っ張られた状態、つまり、後方側にがたつきがない状態であり、かつ前方をがたつき防止部材により、それより前方に移動できないようになっている。よって、第１クランプ３は、チューブ装着位置では、がたつきがないように構成されている。また、接合装置１には、図１および図５に示すように、第１クランプ３（正確には、第１クランプ固定台３ｃ）の後方の最大移動位置を規制する規制部材２５が設けられている。

【００１８】第２クランプ２は、図５、図７および図１０に示すように、ベース２ｂと、このベース２ｂに回転可能に取り付けられたカバー２ａと、ベース２ｂが固定されたクランプ固定台２ｃを有している。そして、このクランプ固定台２ｃは、リニアテーブルに固定されている。リニアテーブルは、クランプ固定台２ｃの下面に固定された移動台２ｃと、移動台２ｃの下部に設けられたレール部材２ｎにより構成されている。そして、このリニアテーブルにより、第２クランプ２は、接合するチューブ４８，４９の軸に対して平行な方向、言い換えれば、第２クランプ２を第１クランプ３に対して、近接および離間する方向にのみ、歪みがなく移動する。

【００１９】また、図５および図７に示すように、接合装置１のフレームとクランプ固定台２ｃとの間には、押圧部材３３が設けられており、常時第２クランプ２（正確には、第２クランプ固定台２ｃ）を第１クランプ側に押している。押圧部材としては、バネ部材が好適に使用される。そして、この押圧部材３３は、第１および第２クランプ３，２によりを２本の可撓性チューブ４８，４９を押し潰すようにして把持した時の、可撓性チューブの反発力より押圧部材３３の押圧力は弱くいものが使用されており、可撓性チューブを把持したとき、第２クランプ２が第１クランプ３より若干は離間する方向に動くように構成されている。よって、この実施例の無菌的接合装置１では、第２クランプ移動機構は、上記のリニアテーブル、モータ、ギア３０、ギア３１、シャフト３２、カム１７、押圧部材３３により構成されている。

【００２０】そして、第１クランプ３および第２クランプ２は、図１０に示すように、保持するチューブを斜めに押し潰した状態で保持するように構成されている。クランプ３，２は、ベース３ｂ，２ｂに旋回可能に取り付けられたカバー３ａ，２ａを有しており、ベース３ｂ，２ｂには、２つのチューブを裁置するために平行に設けられた２つのスロット３ｆ，３ｅおよび２ｆ，２ｅを有している。そして、スロット３ｆ，３ｅとスロット２ｆ，２ｅが向かい合う部分のベース３ｂ，２ｂの端面には、鋸刃状の閉塞部材３ｈ，２ｈが設けられている。そして、カバー３ａ，２ａには、上記のベース３ｂ，２ｂの閉塞部材３ｈ，２ｈに対応する形状の鋸刃状の閉塞部材３ｇ，２ｇが設けられている。カバー３ａ，２ａの内表面は平坦となっている。そして、カバー３ａ，２ａには、それぞれ旋回カムを有しており、この旋回カムは、カバー３ａ，２ａを閉じると、ベース３ｂ，２ｂのローラと係合する。そして、２本のチューブは、カバー３ａ，２ａが閉じられたとき、ベース３ｂの閉塞部材３ｈとカバー３ａの閉塞部材３ｇとの間、およびベース２ｂの閉塞部材２ｈとカバー２ａの閉塞部材２ｇとの間により、斜めに押し潰され、閉塞した状態で保持される。また、第１クランプ３は、第２クランプ方向に突出する突出部３ｉを有し、第２クランプ２が、この突出部３ｉを収納する凹部２ｉを有しているので、第２クランプ２は、第１クランプ１を閉塞しないと、閉塞できないように構成されている。

【００２１】そして、無菌的接合装置１は、図１に示すように、モータにより回転するギア３０と、このギア３０の回転により回転するギア３１を有しており、ギア３１のシャフト３２には、図７に示すように、２つのカム１９，１７が固定されており、カム１９，１７は、ギア３１の回転と共に回転する。そして、カム１９の右側面には、図８に示すような形状の第１クランプ駆動用のカム溝１９ａが設けられている。そして、カム１９のカム溝１９ａ内を摺動するフォロア１８ａを中央部に有する

第１クランプ移動用アーム１８が設けられている。また、アーム１８の下端は、支点１８ｂによりフレーム９に回動可能に支持されており、アーム１８の上端は、第１クランプ３のクランプ固定台３ｃに設けられた支点１８ｃによりに回動可能に支持されている。よって、第１クランプ３は、リニアテーブルのレール部材３ｎに沿って、図８に示すように、カム１９の回転により、カム溝１９ａの形状に従い矢印に示すように、２本のチューブの軸に対して水平状態にて直交方向後方に移動する。

【００２２】切断手段５は、図６に示すように、ウエハーを交換可能に保持するウエハー保持部５ａと、ウエハー保持部５ａの下方に設けられたアーム部５ｃと、アーム部５ｃの端部に設けられたフォロア５ｂと、ヒンジ部５ｄと、フレーム９への取付部５ｅを有している。そして、ヒンジ部５ｄによりフレーム９に対して旋回可能となっている。そして、図６に示すように、切断手段５の右側面には、ウエハー加熱用の電気接続端子９、ウエハーの温度検知のための温度検知手段７が固定されている。温度検知手段７としては、熱電対または測温抵抗体であることが好ましい。より好ましくは、シース形熱電対または測温抵抗体であるり、特に、シース形熱電対が好ましい。ウエハー６としては、向かい合うように折り曲げられた金属板と、この金属板の内面に形成された絶縁層と、この絶縁層内に上記の金属板と接触しないように形成された抵抗体と、この抵抗体の両端部に設けられた通電用端子とを有するものが好適に使用される。

【００２３】そして、カム１７は、図６および図９に示すように、左側面に切断手段駆動用のカム溝１７ａを有している。そして、切断手段５のフォロア５ｂは、カム１７のカム溝１７ａ内に位置しており、カム溝１７ａ内をカム溝の形状に沿って摺動する。よって、切断手段５は、図９に示すように、カム１７の回転により、カム溝１７ａの形状に従い上下に、言い換えれば、２本のチューブの軸に対して、直交かつ垂直方向上下に移動する。さらに、カム１７は、図７に示すように、中央部に第２クランプ２の駆動用のカム溝１７ｃを有している。カム溝１７ｃは、左側面１７ｆおよび右側面１７ｅを有しており、左側面１７ｆおよび右側面１７ｅにより、第２クランプの位置を制御する。第２クランプ固定台２ｃには下方にのびる突出部を有しており、その先端にはフォロア２０が設けられている。このフォロア２０は、第２クランプ２の駆動用のカム溝１７ｃ内を摺動する。そして、図７に示すように、フォロア２０とカム溝１７ｃの側面間には、若干の隙間ができるように形成されている。そして、第２クランプ固定台２ｃは、バネ部材３３により常時押されているため、通常状態では、フォロア２０は、カム溝１７ｃの左側面１７ｆに当接するようになり、フォロア２０とカム溝１７ｃの右側面１７ｅとの間に若干の隙間ができる。しかし、第１および第２クランプ３，２により２本のチューブを保持すると、上述のように、２つのクランプ３，２はそれぞれ、２本のチューブを押し潰すように閉塞し保持するため、チューブの閉塞に起因する反発力が生ずる。そして、バネ部材３３は、上記チューブの閉塞に起因する反発力より小さい力のものが用いられているため、クランプ３，２がチューブを保持する状態では、図７に示すように、フォロア２０は、カム溝１７ｃの右側面１７ｅに当接するようになり、フォロア２０とカム溝１７ｃの左側面１７ｆとの間に若干の隙間ができる。しかし、上述の切断手段５によりチューブが切断されと、チューブの閉塞に起因する反発力が消失するため、通常状態に戻り、フォロア２０は、カム溝１７ｃの左側面１７ｆに当接するようになり、フォロア２０とカム溝１７ｃの右側面１７ｅとの間に若干の隙間ができる。このように、バネ部材３３の作用およびチューブの反発力により、フォロア２０が当接するカム溝の摺動面が経時的に変化するように構成されている。

【００２４】そして、図７に示すように、左側面１７ｆに凹部１７ｄが形成されている。この凹部１７ｄ部分をフォロア２０が通過する時期は、切断手段によりチューブの切断後であるため、フォロア２０は、カム溝１７の左側面１７ｆを沿って摺動している状態であり、よって、フォロア２０は凹部１７部分に入る。このため、凹部１７ｄの深さ分だけ、第２クランプ２が第１クランプ３方向に移動することになる。これにより、チューブの接合がより確実となる。そして、カム溝１７ｃの右側面１７ｅにも凹部１７ｇが設けられている。この凹部１７ｇは、クランプ３，２の内面の清掃のためのものである。この凹部１７ｇを設けることにより、第２クランプ２をバネ部材３３側に押すことにより、フォロア２０が凹部１７ｇに当接するまで、第２クランプ２を第１クランプ３より離間する方向に移動することができ、これにより、第１クランプ３と第２クランプとの間に隙間が形成される。形成された間隙内に清掃部材、例えば、アルコールなどのある程度切断されるチューブの形成材料を溶解できる溶剤を含有した綿棒により清掃することが可能となる。この凹部１７ｇは、図７に示すように、左側面１７ｆの凹部１７ｄ（第２クランプ２の幅寄せが行われる部分）とほぼ向かい合う位置に設けられている。第２クランプ固定台２ｃの下方にのびる突出部に設けられたフォロア２０が凹部１７ｄ部分に入っているときは、チューブ切断後、目的とするチューブ相互を接合した状態であり、この状態にて、第２クランプは停止する。また、第１クランプも既に停止しており、かつ、第１クランプ３は、第２クランプとずれた位置にある。具体的には、図１に示すように、第１クランプ３が、第２クランプ２より後退しており、第１クランプ３は、第２クランプとずれた位置にある。このため、この状態では、第２クランフ２の先端部の内面が若干露出しており、さらに、第１クランフの後端部の内面も若干露出している。

よって、露出した第２クランプ２の内面および第１クランプ３は、その清掃が容易である。

【００２５】次に、本発明の無菌的接合装置１の作用を図面を用いて説明する。図１１は、切断手段、第１クランプ、第２クランプの動作を示すタイミングチャートである。図１２，図１３および図１４は、無菌的接合装置の作用を説明するためのフローチャートである。図１５、図１６、図１７および図１８は、無菌的接合装置の作用を説明するための説明図である。この接合装置１では、接合作業終了時の第１クランプ３は、第２クランプ２とずれた位置となっており、図１１のタイミングチャートの停止位置にある。図１１のタイミングチャートの横軸の角度は、原点（第１クランプと第２クランプの位置があっている状態）を０°とし、その後のギア３１のシャフト３２の回転角度、言い換えれば、カム１７およびカム１９の回転角度のときの、切断手段（ウエハー）、第１クランプ３、第２クランプ２の動きを示すものである。

【００２６】まず、最初にフローチャートの図１２に示すように、図３のパネル５０に設けられている電源スイッチ５１を押す。これにより、図３に示す制御器４０を構成するＣＰＵにより、接合装置１は、異常が無いか（具体的には、内部コネクタの抜けがないか、熱電対の断線がないか、内部定電圧源に不良がないか）を判断し、以上がある場合は、ブザーが鳴動する。続いて、図３のパネル５０に設けられているクランプリセットスイッチ５３を押す。ＣＰＵにより、第１および第２クランプが開いているか否か、第１および第２クランプが原点にないか否か、ウエハー交換レバーが原点にあるか否かを判断する。なお、この実施例の無菌的接合装置１で使用するクランプは、上述のように、第１クランプ３が、第２クランプ方向に突出する突出部３ｉを有し、第２クランプ２が、この突出部３ｉを収納する凹部２ｉを有しているので、第２クランプ２は、第１クランプ１を閉塞しないと、閉塞できないように構成されている。このため、第１および第２クランプが開いていることは、第２クランプが閉塞されたときに、接触するレバー１６と、このレバー１６によりＯＮ／ＯＦＦされるマイクロスイッチ１３により検知される。具体的には、マイクロスイッチ１３は、第２クランプが解放状態のときは、ＯＦＦとなており、第２クランプ２が閉塞されたときにレバー１６と接触し、レバー１６が動きマイクロスイッチ１３をＯＮ状態とする。このマイクロスイッチ１３のＯＮ／ＯＦＦ信号は、制御器４０に入力される。第１および第２クランプが原点にないことは、それぞれのカムの円周上に設けられた溝をマイクロスイッチＳＷ５（７３），ＳＷ６（７４）が検知することにより判断される。ウエハー交換レバー２２が原点にあることは、マイクロスイッチ１４により検知される。レバー２２が、原点にある場合は、マイクロスイッチ１４がＯＮとなり、原点にない場合は、ＯＦＦとなり、このマイクロスイッチ１４のＯＮ／ＯＦＦ信号は、制御器４０に入力される。

【００２７】そして、図１２に示すように、上述の４つの点すべてがＹＥＳの場合、モータを作動させ、第１および第２クランプを原点に復帰させる。また、上述の４つの点のうちいずれか１つでもＮｏの場合、ブザーが鳴動し、異常ランプが点灯し、手動解除を行い、リセットスイッチを押すことにより、異常ランプが消灯する。第１および第２クランプが原点に到達した後、２本の可撓性チューブ４８，４９を第１および第２クランプに装着する。この状態での第１および第２クランプ３，２は、図１０に示すように、両者とも開放した状態であり、かつ両者に設けられたスロット３ｅと２ｅおよび３ｆと２ｆは互いに向かいあった状態となっている。そして、使用中のチューブ４９を手前側のスロット３ｆ，２ｆに装着し、接続される未使用のチューブ４８を奥側のスロット３ｅ，２ｅに装着する。そして、上記のように第１および第２クランプ３を閉塞した後、ウエハー交換レバー２２をクランプ側に押して、ウエハーを交換する。ウエハー交換レバー２２をクランプ側に押すことにより、ウエハーカートリッジ８内より、新しいウエハーが取り出され、新しいウエハーが、切断手段５に装着されている待機ウエハーを押し、待機ウエハーが切断手段５に装着されていた使用済ウエハーを押し、待機ウエハーが使用位置に装着されるとともに、使用済ウエハーは、使用済ウエハー収納箱２９内に収納される。続いて、パネル５０の開始スイッチ５２を押すと図１３のフローチャートの②に移行し、図３に示す制御器４０を構成するＣＰＵにより、第１および第２クランプが閉じているか否か、ウエハーが交換済であるか否か、第１および第２クランプが原点にあるか否か、ウエハー交換レバーが原点にあるか否か、第１および第２クランプが閉じているか否かは、第２クランプが閉塞されたときに、接触するレバー１６と、このレバー１６によりＯＮ／ＯＦＦされるマイクロスイッチ１３により検知される。具体的には、マイクロスイッチ１３は、第２クランプが解放状態のときは、ＯＦＦとなっており、第２クランプ２が閉塞されたときにレバー１６と接触し、レバー１６が動き、マイクロスイッチ１３をＯＮ状態とする。このマイクロスイッチ１３のＯＮ／ＯＦＦ信号は、制御器４０に入力される。ウエハーが交換済であるか否かは、ウエハー交換レバー２２をクランプ方向に押し、ウエハー交換作業を行うと、交換レバー２２は、マイクロスイッチ１５を一度ＯＮさせるので、マイクロスイッチ１５からのＯＮ信号により交換されたか否か検知される。マイクロスイッチ１５のＯＮ／ＯＦＦ信号は、制御器４０に入力される。第１および第２クランプが原点にあるか否かは、上述のようにマイクロスイッチ５，６により検知する。

【００２８】そして、図１３に示すように、上述の４つの点のいずれか１つでもＮｏの場合、ブザーが鳴動し、

図１２の③にもどる。また、上述の４つの点のすべてがＹＥＳの場合、動作中ランプ４７が点灯し、ウエハーの加熱が開始される。ウエハーの加熱開始後、ウエハー電流が設定値以上であるか判断し、これは、ウエハーが短絡しているはを判断するためである。そして、ウエハー電流が設定値以下（シャント抵抗にかかる電圧が所定値以上）でない場合は、０．３秒待った後に、ウエハー電流が設定値範囲内であるか判断する。これは、ウエハーが使用済のものである場合、抵抗体の熱履歴のために、抵抗値が低下するため、ウエハー電流を測定し、あらかじめ設定したウエハー電流と比較し、設定範囲内（許容範囲内）であるかを検知し、これにより、ウエハーが使用済であるかを電気的に判断する。上記のウエハー電流が設定値以上である場合（ウエハーが短絡している場合）および、上述のウエハー電流が設定範囲内でない場合（ウエハーが使用済みの場合）は、ブザーが鳴動し、ウエハーの加熱を停止し、ウエハー異常ランプが点灯し、リセットスイッチが押された後、図１２のフローチャート⑤に移行する。そして、ウエハー電流と比較し、設定範囲内（許容範囲内）である場合は、ウエハーの加熱が継続される。ウエハー６の加熱は、ウエハー温度検知手段である熱電対７の温度検知出力に基づいて、算出されるパルス幅変調信号により定電圧源４３を制御しながら行われる。そして、ウエハーの過剰加熱を防止するために、ウエハーの加熱時間が所定時間内であるか判断し、また、ウエハー電流が所定値以下であるか判断し、所定値以下、つまりウエハーが短絡事故を起こしている場合は、直ちにブザーが鳴動し、ウエハーの加熱を停止し、図１２のフローチャート⑤に移行する。そして、ウエハーの温度が設定温度に達すると、図１４のフローチャート④に移行し、モータが作動し、これにより、ギア３０、ギア３１、カム１９，１７が回転し、切断手段（ウエハー）の上昇し、チューブの切断、第１クランプの後退、切断手段（ウエハー）の下降、第２クランプの第１クランプ側への幅寄せが行われる。

【００２９】具体的に説明すると、まず、カム１７が矢印方向に回転することにより、切断手段５のフォロア５ｂは、カム溝１７ａ内を摺動をする。当初図９および図１１に示すカム溝の原点Ｏがフォロア５ｂと接触していた状態より、図９および図１１に示すカム溝１７ａの点Ａがフォロア５ｂと接触するようになる。そして、図９および図１１に示すカム溝１７ａの点Ａがフォロア５ｂと接触する状態から、カム溝１７ａの点Ｂがフォロア５ｂと接触する状態に至るまでの間、図１１に示すように、なだらかに切断手段５は上昇し、この間において、２本の可撓性チューブが切断される。図１５および図１６を用いて説明すると、２本のチューブ４８，４９は、第１クランプ３および第２クランプ２により保持されており、第１クランプ３および第２クランプ２の間に位置するチューブ部分４８ａ，４９ａが形成され、その下方に切断手段のウエハー６が位置している。そして、上述のように、カム１７の回転により、切断手段５（ウエハー６）が上昇することにより、図１６に示すように、２本のチューブの第１クランプ３および第２クランプ２の間に位置するチューブ部分４８ａ，４９ａにて両者を溶融切断する。

【００３０】そして、図９に示すカム溝１７ａの点Ｂがフォロア５ｂと接触する状態から、カム溝１７ａの点Ｃがフォロア５ｂと接触する状態に至るまでの間、図９および図１１に示すように、切断手段５は、上昇した状態が維持され、チューブ４８ａ，４９ａの切断された端部を十分に溶解する。そして、図９および図１１に示すカム溝１７ａの点Ｃがフォロア５ｂと接触する状態から、カム溝１７ａの点Ｅがフォロア５ｂと接触する状態に至るまでの間、図９および図１１に示すように、なだらかに切断手段５は下降する。また、図８に示すように、カム１９が矢印方向に回転することにより、第１クランプを移動させるためのアーム１８に設けられたフォロア１８ａは、カム溝１９ａ内を摺動をする。当初図８および図１１に示すカム溝の原点Ｏがフォロア１８ａと接触していた状態より、図８および図１１に示すカム溝１９ａの点Ｆがフォロア１８ａと接触するようになる。図１１のタイミングチャートに示すように、切断手段５のフォロア５ｂがカム溝１７ａの点Ｂに至るより若干早く、フォロア１８ａは、カム溝１９ａ点Ｆに至る。そして、図８および図１１に示すように、カム溝１９ａの点Ｆがフォロア１８ａと接触する状態から、カム溝１９ａの点Ｇがフォロア１８ａと接触する状態に至るまでの間、図１１に示すように、徐々に第１クランプ３は後退し、図１７に示す状態となり、接合されるチューブ部分４９ａと４８ａがウエハー６を介して向かい合った状態となる。この状態は、図１１のタイミングチャートに示すように、カム溝１９ａの点Ｇがフォロア１８ａと接触する状態から、カム溝１７ａの点Ｃがフォロア５ｂと接触する状態に至るまでの間維持される。そして、第１クランプの位置は、点Ｇがフォロア１８ａと接触する状態から、カム溝１９ａの点Ｈがフォロア１８ａと接触する状態に至るまでの間、図１７の状態が維持される。なお、切断手段５は、上述のように、図９および図１１に示すカム溝１７ａの点Ｃがフォロア５ｂと接触する状態から、カム溝１７ａの点Ｅがフォロア５ｂと接触する状態に至るまでの間、図９および図１１に示すように、なだらかに下降し、接合されるチューブ部分４８ａ，４９ａが当接する。

【００３１】そして、切断手段５の下降が終了した状態、言い換えれば、カム溝１７ａの点Ｅがフォロア５ｂと接触する状態に至ったときとほぼ同時に、図７および図１１に示すように、第２クランプ２が、第１クランプ側に幅寄せを行う。具体的には、図７および図１１に示すように、カム溝１７ｃの左側面１７ｄの点Ｎが、第２

クランプ２を駆動させるためのフォロア２０と接触する状態から、左側面の点Ｌがフォロア２０と接触する状態に至るまでの間、徐々に、第２クランプ２は、第１クランプ３側に移動し、カム溝１７ｃの凹部１７ｄの点ＬＫが、フォロア２０と接触する状態から、凹部１７ｄの点Ｋがフォロア２０と接触する状態に至るまでの間、幅寄せした状態を維持する。この幅寄せにより、チューブ部分４８ａ，４９ａの両者は確実に密着するので、両者の接合をより確実なものとにすることができる。そして、カム溝１７ｃの凹部１７ｄの点Ｋが、フォロア２０と接触する状態から、左側面１７ｆの点Ｊがフォロア２０と接触する状態に至るまでの間、徐々に、第２クランプ２は、第１クランプ３側より離れる方向に移動し、この状態てに、モータの作動が停止する。

【００３２】よって、停止した位置での、第１クランプ３は、第２クランプ２の位置は、図１８に示すように、図１７と同様にずれた位置となっている。そして、図１４のフローチャートに示すように、熱電対によりウエハー温度が検知され、ウエハー温度が設定値以下になると、動作ランプが消灯し、ブサーが鳴動する。そして、図１８に示すように、第１クランプ２および第２クランプ３を開き、チューブを取り出すことにより、チューブの接合作業が終了する。　また、図１４のフローチャートには記載していないが、図７および図１１に示すカム溝１７ａの点Ａがフォロア５ｂと接触する状態より、カム溝１７ａの点Ｃがフォロア５ｂと接触する状態に至るまでの間、言い換えれば、切断手段５が上昇を開始してから下降を開始するまでの間も、図１３のフローチャートに示すようにウエハーが設定温度であるかを判断し、ウエハー温度検知手段である熱電対７の温度検知出力に基づいて、算出されるパルス幅変調信号により定電圧源４３を制御し、ウエハーの温度制御を行うことが好ましい。これは、一度ウエハーが設定温度に到達しても、切断するチューブ４８，４９にウエハーが接触することにより、ウエハーの熱がチューブにより吸収され低下するため、その補償行うためである。特に、上述のように、図４における加熱制御回路５５が、温度検知手段７である熱電対からの温度検知信号ａを、補正ウエハー温度算出部５６であるＰＩＤ補正器５６（比例・微分・積分補正器１）により補正し、補正した補正温度信号ｂを出力するものとし、その補正を式１

$$b=1/K\cdot a\cdot(1+K1\cdot T\cdot da/dt)\quad\cdots(1)$$

により、補正値を算出するものとすると、補正温度信号ｂは、ウエハーの温度の低下によって、温度検知信号である熱電対の実際の温度が低下するまでの時間遅れを、Ｋ１・Ｔ・ｄａ／ｄｔにて補正しているので、実際のウエハーの低下温度を正確に検知するので、対応早く、ウエハーの温度制御を行うことができる。

【００３３】

【発明の効果】本発明の可撓性チューブ無菌的接合装置は、可撓性チューブを無菌的に接合するための装置であって、該装置は、少なくとも２本の可撓性チューブを平行状態にて保持する第１クランプおよび第２クランプと、該第１クランプおよび第２クランプ間にて前記可撓性チューブを切断するための切断手段と、該切断手段により切断された可撓性チューブの接合される端部相互が密着するように前記第１クランプまたは前記第２クランプの少なくとも一方を移動させる移動手段とを有し、前記切断手段は、前記可撓性チューブを溶融切断するためのウエハーと、該ウエハーを加熱するための定電圧源と、ウエハー温度検知手段と、ウエハー加熱制御手段とを有し、前記ウエハー加熱制御手段は、前記ウエハー温度検知手段の出力に基づいて、算出されるパルス幅変調信号出力部を有し、該パルス幅変調信号により前記定電圧源を制御するものである。特に、定電圧源とパルス幅変調信号回路を用いることにより、消費電力を小さいものとすることができ、さらに、パルス幅変調信号により定電圧源を制御することにより、可撓性チューブを加熱溶融により切断するためのウエハーの温度制御を確実に行うことができ、確実なチューブの接合を行うことができる。

【図面の簡単な説明】

【図１】図１は、本発明の可撓性チューブ無菌的接合装置の一実施例の斜視図である。

【図２】図２は、図１に示した無菌的接合装置をケースに収納した状態を示す斜視図である。

【図３】図３は、本発明の無菌的接合装置に使用される電気回路の一例を示すブロック図であ

【図４】図４は、本発明の無菌的接合装置の電気回路のウエハー加熱制御手段の一例を示す電気回路ブロック図である。

【図５】図５は、本発明の可撓性チューブ無菌的接合装置の一実施例の上面図である。

【図６】図６は、本発明の可撓性チューブ無菌的接合装置に使用される切断手段の説明図である。

【図７】図７は、第１クランプ、第２クランプおよび切断手段の動作を説明するために説明図である。

【図８】図８は、第１クランプの動作を説明するための説明図である

【図９】図９は、切断手段の動作を説明するための説明図である。

【図１０】図１０は、本発明の無菌的接合装置に使用される第１および第２クランプの一例を示す斜視図である。

【図１１】図１１は、第１クランプ、第２クランプおよび切断手段の動作タイミングを示すタイミングチャートである。

【図１２】図１２は、本発明の無菌的接合装置の作用を

説明するためのフローチャートである。

【図１３】図１３は、本発明の無菌的接合装置の作用を説明するためのフローチャートである。

【図１４】図１４は、本発明の無菌的接合装置の作用を説明するためのフローチャートである。

【図１５】図１５は、本発明の無菌的接合装置の作用を説明するための説明図である。

【図１６】図１６は、本発明の無菌的接合装置の作用を説明するための説明図である。

【図１７】図１７は、本発明の無菌的接合装置の作用を説明するための説明図である。

【図１８】図１８は、本発明の無菌的接合装置の作用を説明するための説明図である。

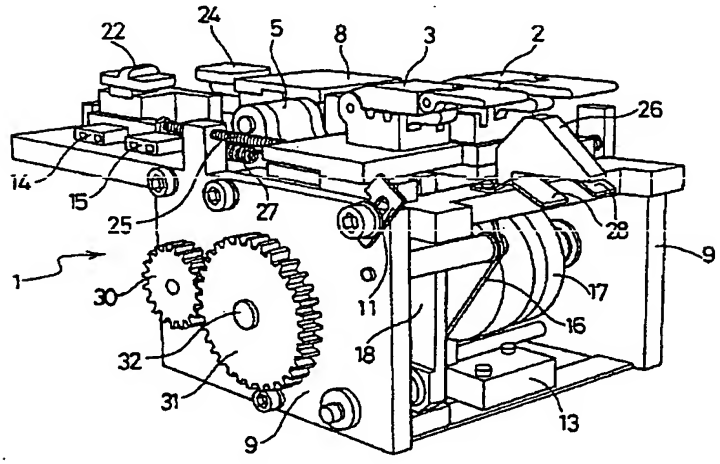
【図１９】図１９は、定電流源を用いた加熱手段の回路の概略図である。

【図２０】図２０は、定電圧源を用いた加熱手段の回路の概略図である。

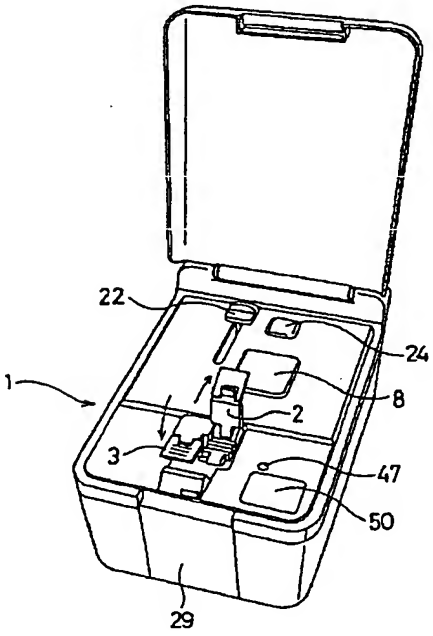
【符号の説明】

１　無菌的接合装置
２　第２クランプ
３　第１クランプ
５　切断手段
６　ウエハー
７　ウエハー温度検知手段
１３　マイクロスイッチ１
１４　マイクロスイッチ２
１５　マイクロスイッチ３
４０　制御器
４１　整流電源回路
４２　モーター
４３　定電圧源
４４　ウエハー加熱制御手段
５０　入力パネル
５９　パルス幅変調信号出力部
６５　ウエハー短絡保護回路

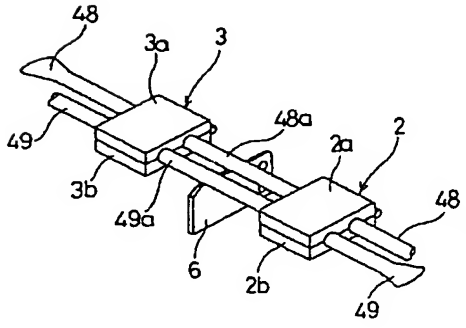
【図１】



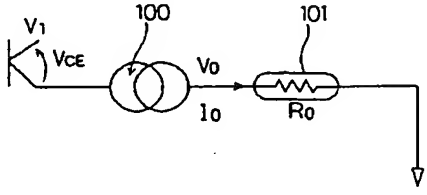
【図２】



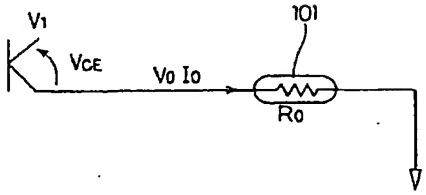
【図１５】



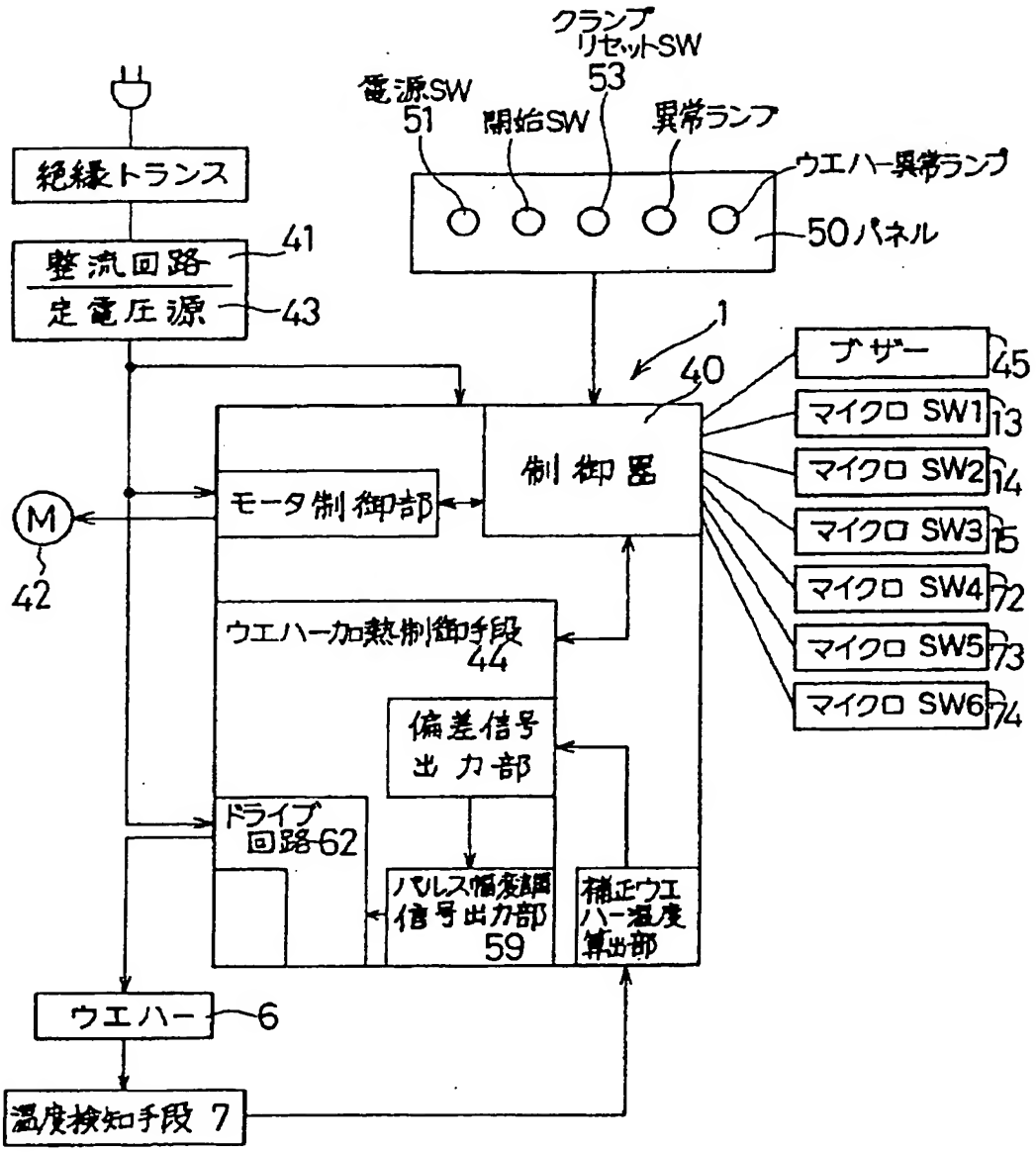
【図１９】



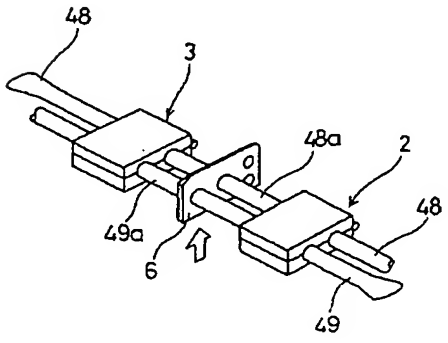
【図２０】



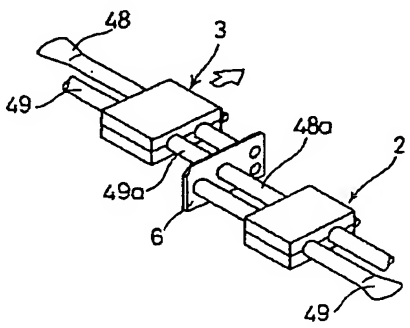
【図３】



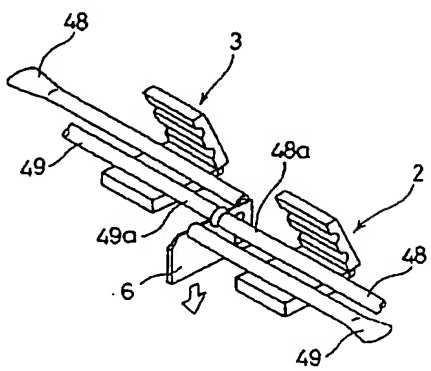
【図１６】



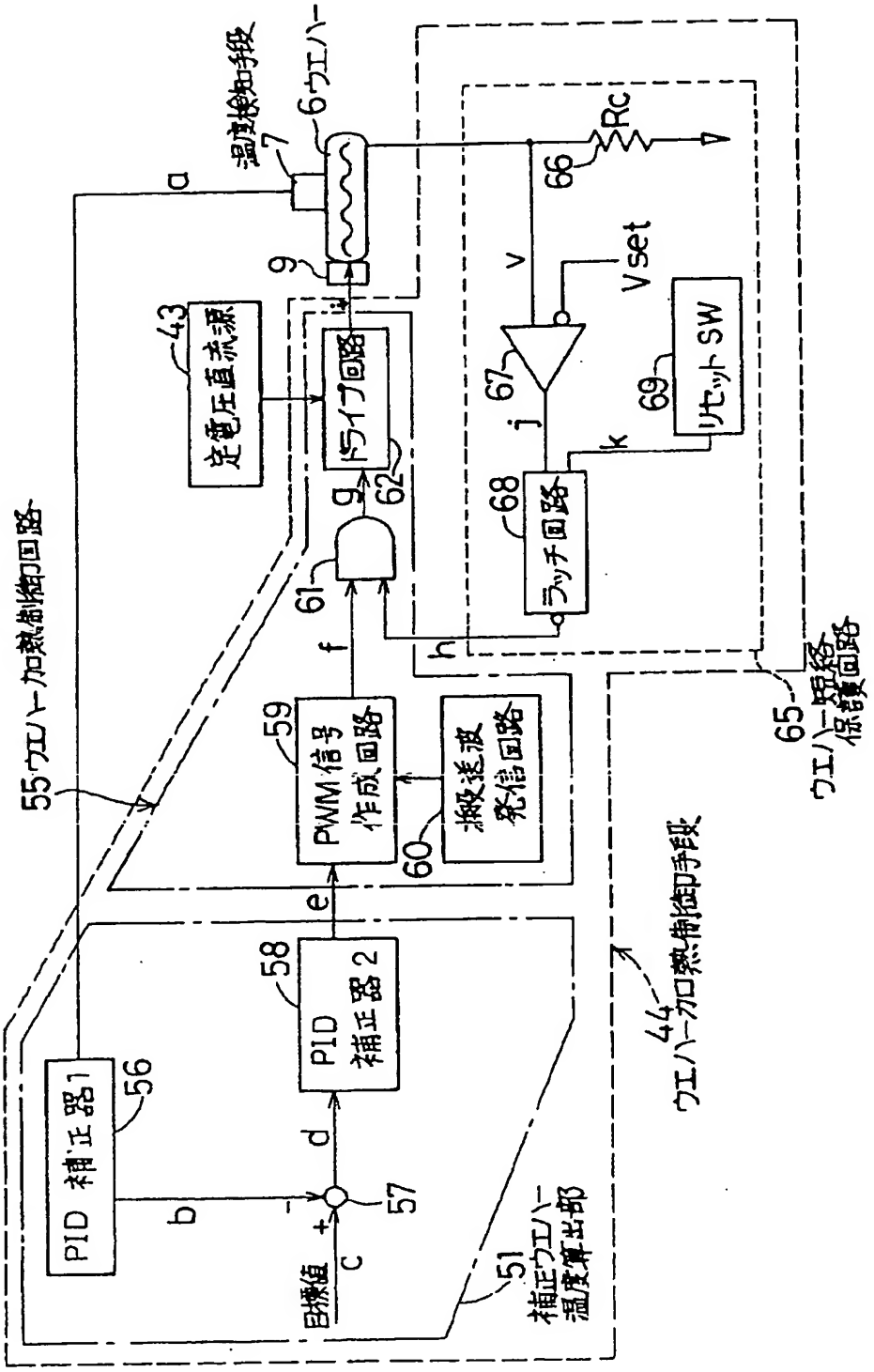
【図１７】



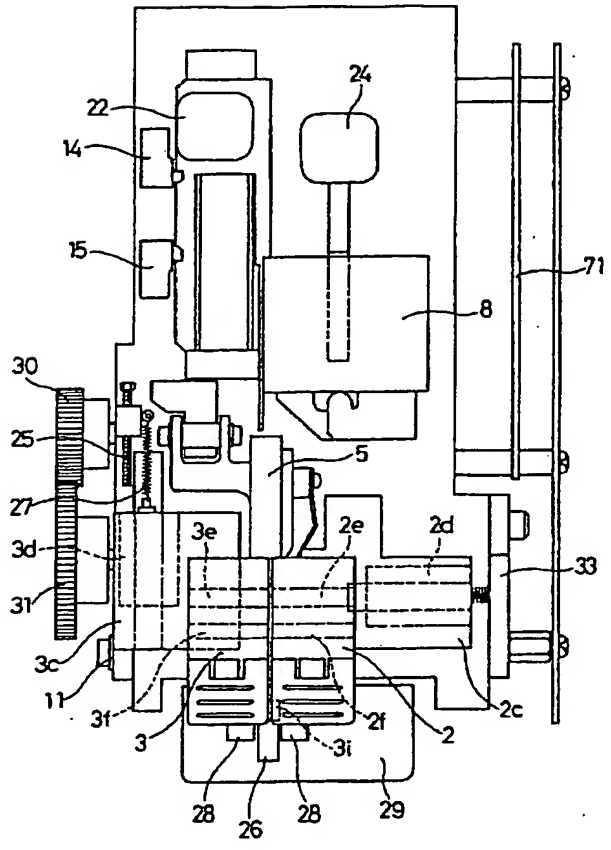
【図１８】



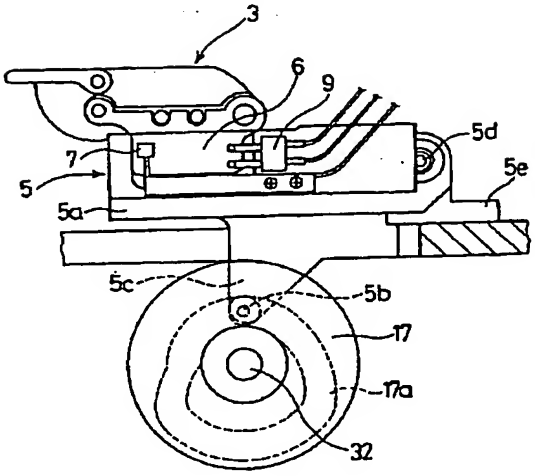
【図４】


55 ウエハー加熱制御回路
温度検知手段
6 ウエハー
7
9
a
43
定電圧直流源
ドライブ回路
62
61
g
f
h
59
PWM信号作成回路
60
搬送波発信回路
e
58
PID補正器2
56
PID補正器1
b
d
57
目標値
c
51
補正ウエハー温度算出部
44
ウエハー加熱制御手段
65
ウエハー保護回路
Rc
66
v
Vset
67
p
i
68
ラッチ回路
q
k
69
リセットSW

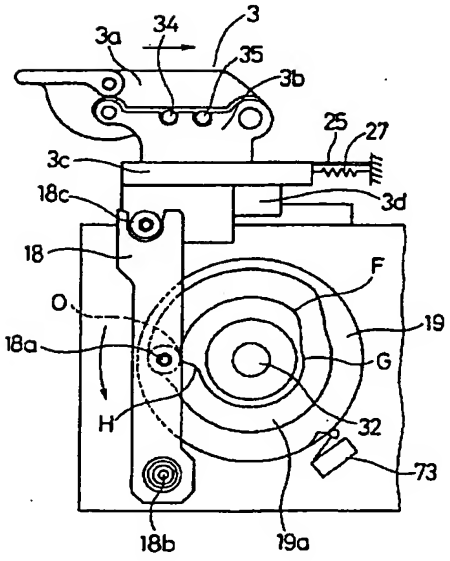
【図５】


22
24
14
15
71
8
30
25
5
27
3d
3e
2e
2d
33
31
3c
11
31
3
2f
3i
2
2c
28
26
28
29

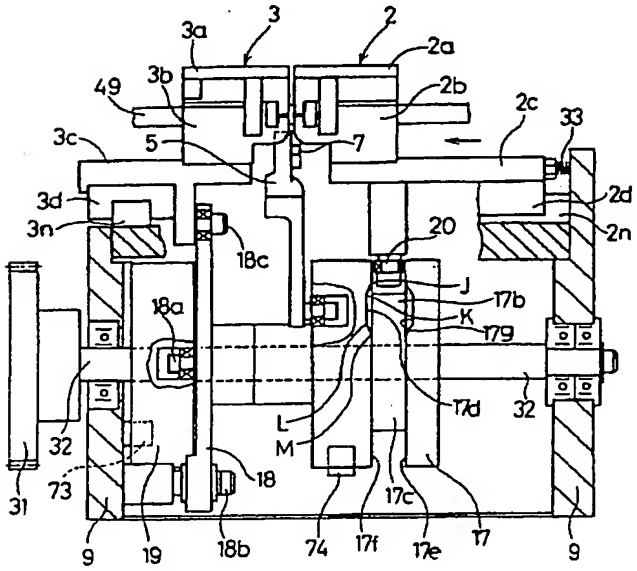
【図６】


3
6
9
5d
7
5e
5
5a
5c
5b
17
17a
32

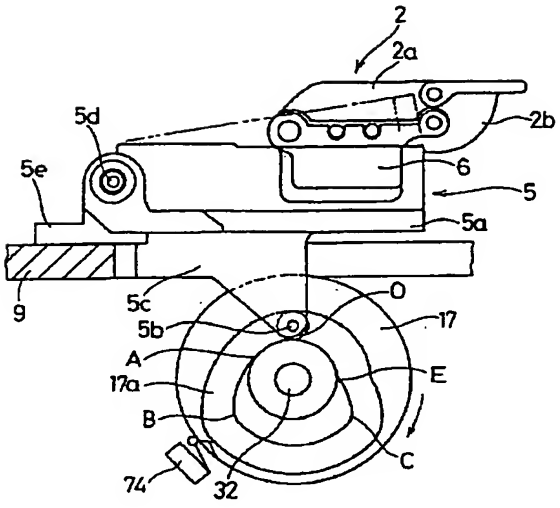
【図８】


3a
34
3
35
3b
25
27
3c
18c
3d
18
F
O
19
18a
G
H
32
73
18b
19a

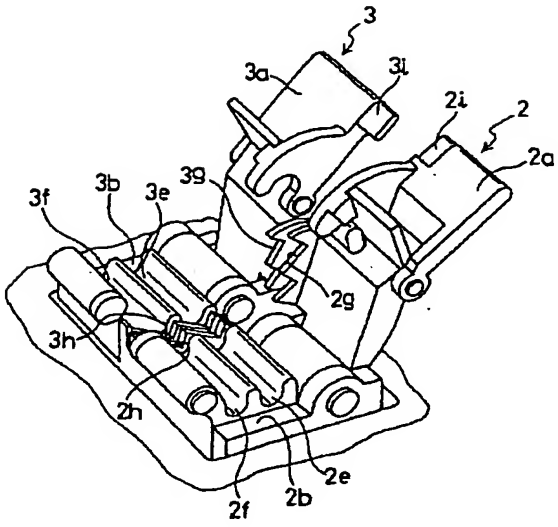
【図７】


3a
3
2
2a
49
3b
2b
2c
33
3c
5
7
2d
3d
3n
20
2n
18c
J
17b
18a
K
17g
32
17d
L
M
32
73
18
31
17c
9
19
18b
74
17f
17e
17
9

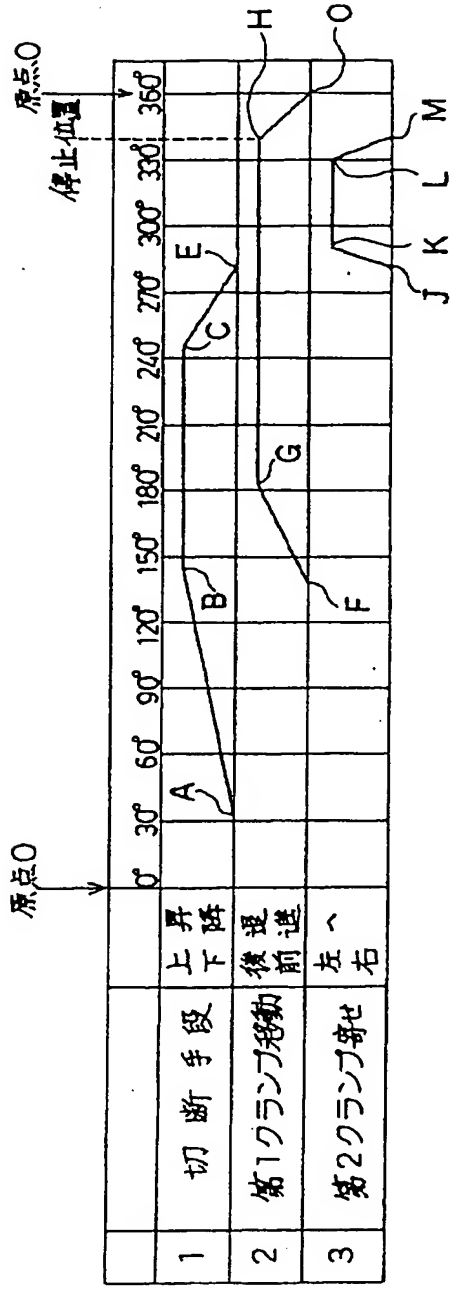
【図９】


2
2a
2b
5d
5e
6
5
5a
9
5c
5b
A
17a
B
74
32
O
17
E
C

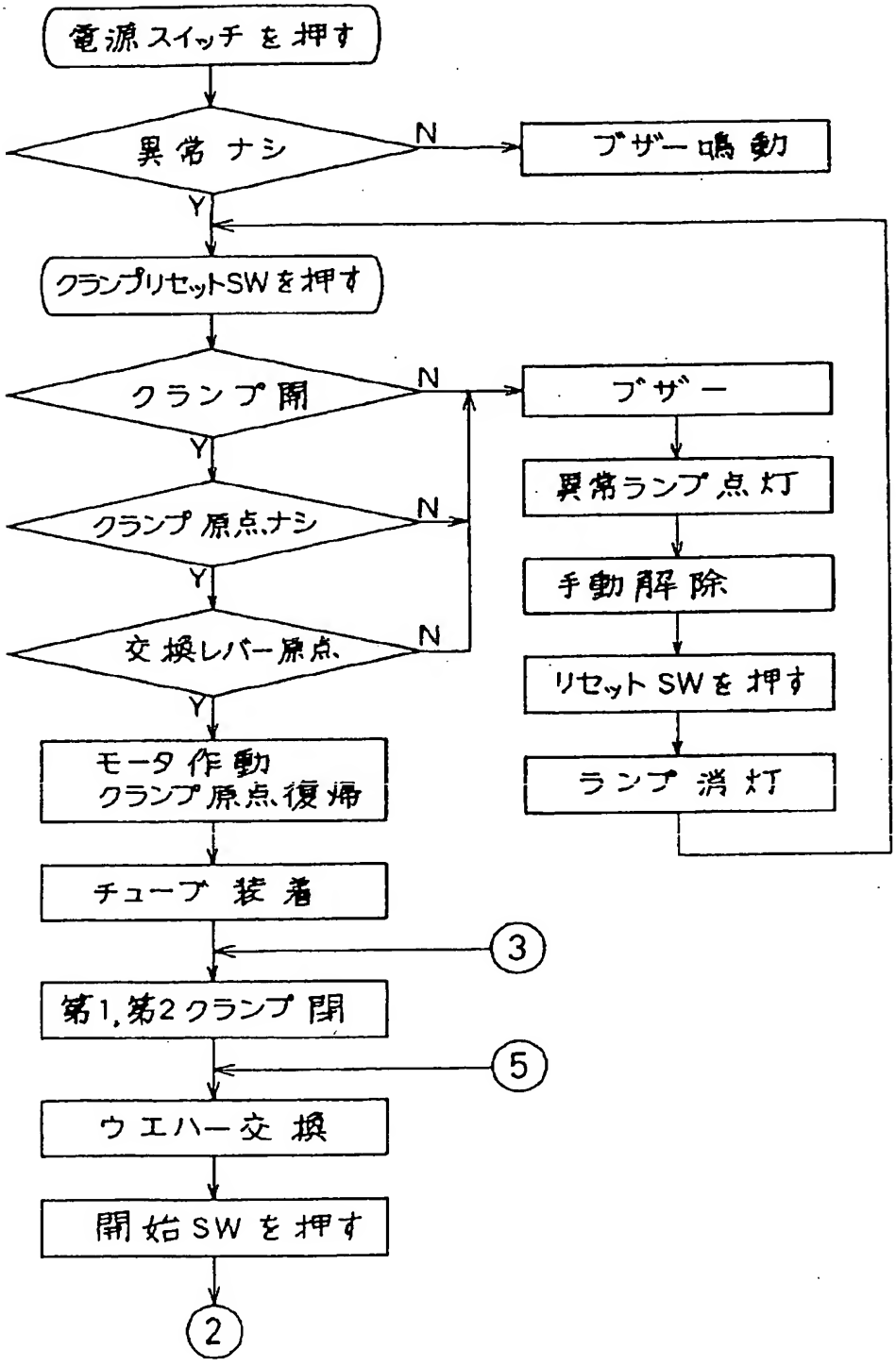
【図１０】


3
3a
3i
2i
2
2a
3f
3b
3e
3g
2g
3h
2h
2f
2b
2e

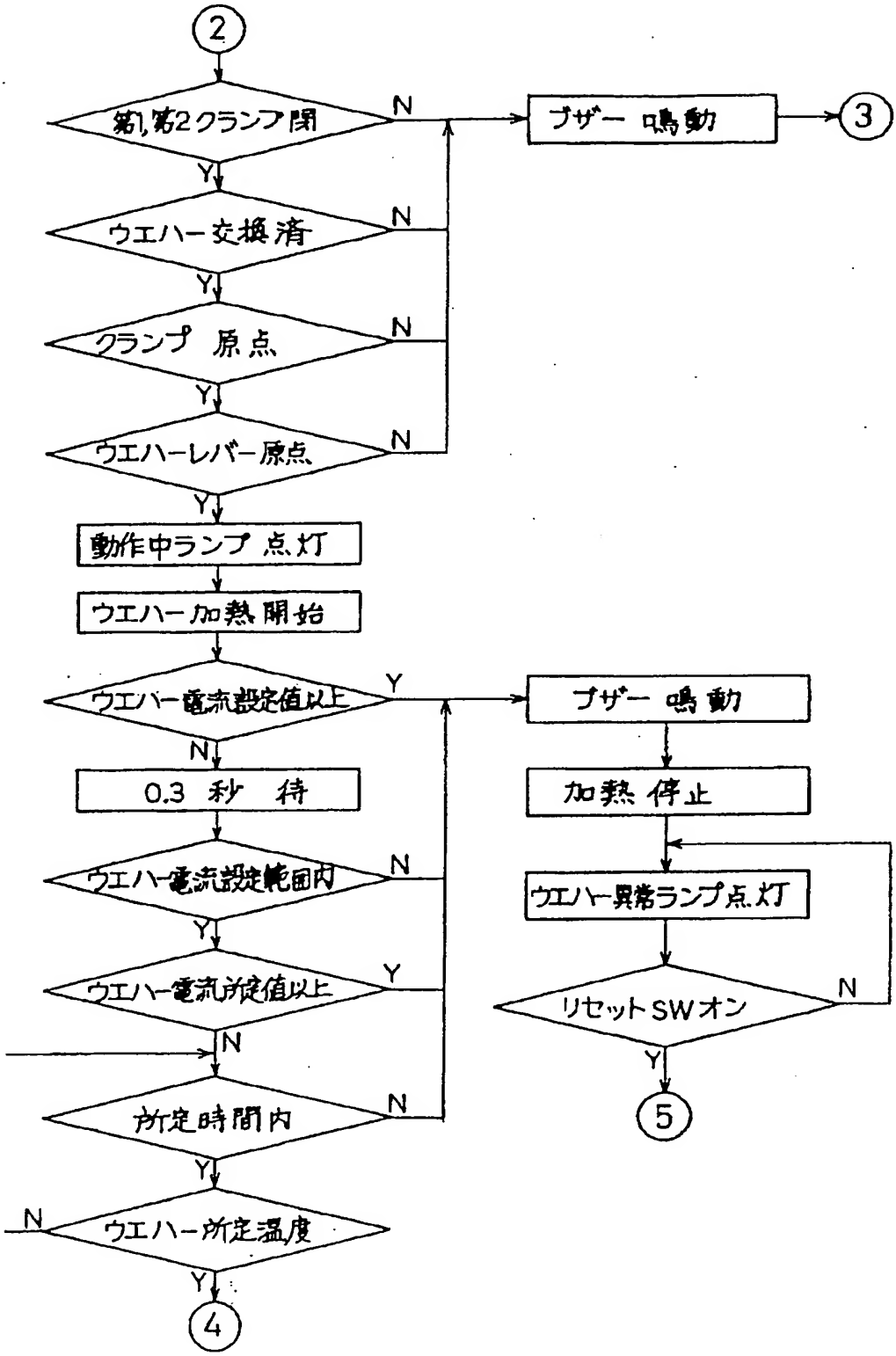
【図１１】


原点O
停止位置
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°
360°
A
B
C
D
E
F
G
H
I
J
K
L
M
1 切断手段
上昇 下降
2 第1クランプ移動
後退 前進
3 第2クランプ移動
左 ～ 右

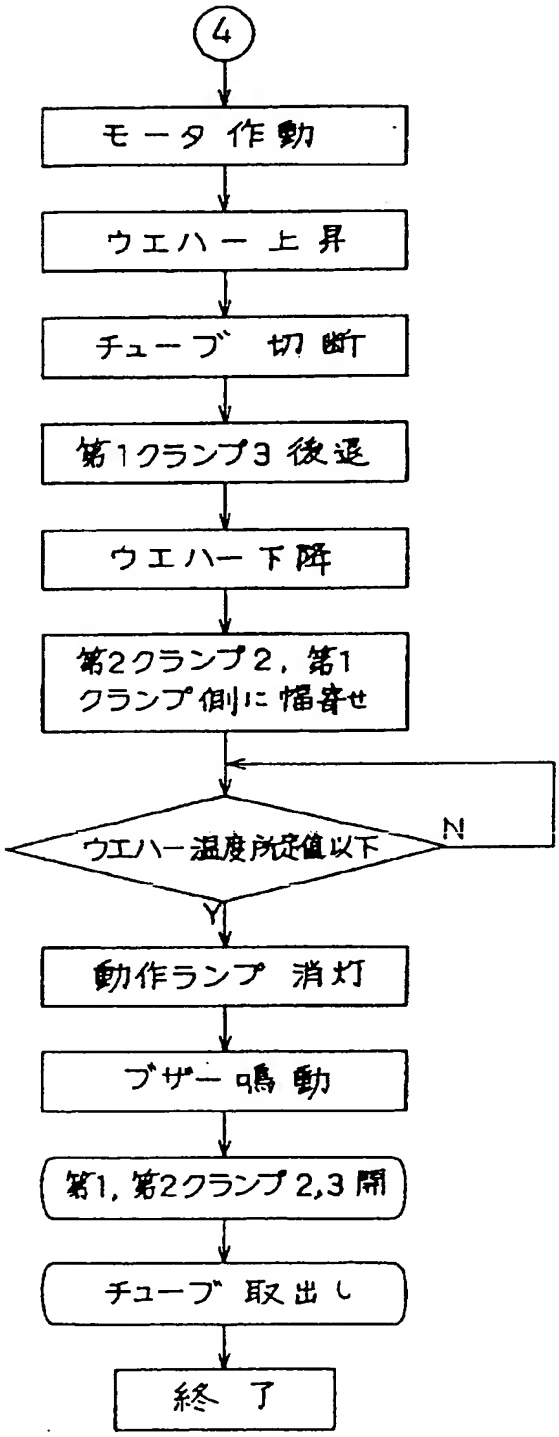
【図１２】


電源スイッチを押す
異常ナシ
N
ブザー鳴動
Y
クランプリセットSWを押す
クランプ閉
N
ブザー
Y
異常ランプ点灯
クランプ原点ナシ
N
手動解除
Y
交換レバー原点
N
リセットSWを押す
Y
モータ作動
クランプ原点復帰
ランプ消灯
チューブ装着
3
第1,第2クランプ閉
5
ウエハー交換
開始SWを押す
2

【図１３】


2
第1,第2クランプ閉
N
ブザー 鳴動
3
Y
ウエハー交換済
N
Y
クランプ 原点
N
Y
ウエハーレバー原点
N
Y
動作中ランプ 点灯
ウエハー加熱 開始
ウエハー電流設定値以上
Y
ブザー 鳴動
N
0.3 秒 待
加熱 停止
ウエハー電流設定範囲内
N
ウエハー異常ランプ点灯
Y
ウエハー電流所定値以上
Y
リセットSWオン
N
N
Y
所定時間内
N
5
Y
N
ウエハー所定温度
Y
4

【図１４】


4
モータ作動
ウエハー上昇
チューブ切断
第1クランプ3後退
ウエハー下降
第2クランプ2，第1クランプ側に幅寄せ
ウエハー温度所定値以下
N
Y
動作ランプ消灯
ブザー鳴動
第1，第2クランプ2,3開
チューブ取出し
終了